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EOSDIS Core System Project

Ancillary Data in the ECS

Study Report

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1. Introduction

1.1 Identification

This is a study report developed by the ECS team for internal use. It is not a formal deliverable but it will provide input to formal deliverables and background for developments. It's heritage is with a white paper:

"Ancillary Data in the EOSDIS Core System", Issue 1.1 March 1994,

which discusses options for dealing with ancillary data and proposes a study. This document is the result of that proposal and goes as far as is currently possible in the collection of information.

1.2 Scope and Objectives

This document comprises information and analysis relating to the ancillary data requirements of the EOSDIS processing chains. It attempts to bring together in one document a dispersed set of information concerning the sources of these inputs and the means by which they are supplied to science algorithms in the various processing chains. Only those data sets used in routine processing are addressed; i.e. ancillary data and not correlative data. The focus is on TRMM and AM instruments although AIRS is included.

This study is necessary as input to:

- defining the ancillary data handling tools of the PGS toolkit
- defining the pre-processing functionality of the ECS
- NASA/ESDIS as an aid in determining which ancillary data sources should be supported
- detailed interface specification work in the sense that the information and analysis are required before firm decisions regarding input data can be made.

The information gathered is presented in the appendices to this document on a per instrument basis using the input structures defined by the software development teams associated with each instrument as well as the SPSO tables. This covers eight appendices dealing with each instrument and additionally, the assimilation and modeling work at GSFC. The data assimilation work at GSFC has been included since it's operation from a processing point of view will have many similarities to those of instrument processing chains. The number of parameters/data sets dealt with in each chapter may evolve through time; however, the information content of each parameter/data set sub-section is presented in the same structure.

The analysis of the information in Chapter 2 is on a per ancillary data set, per source and per requirement basis. It presents summary information and develop conclusions and proposals for the immediate way forward.

1.3 Study Technique

The study has two components, information gathering and analysis. The information has been derived from three sources:

- the NASA SPSO database which provides a listing of ancillary data requested by instrument groups
- instrument teams and investigators in the form of documentation, meetings and telephone conversations
- product and other specifications from internal and external sources

This information is used firstly to collate relevant facts about ancillary inputs to processing chains as described in appendices A through H. A tool which traces paths from specified products to the dependency has been developed to ensure that a systematic view has been taken. This tool produces the tables used in the appendices as well as those found in Appendix I. The parameter numbers are either those of specified EOS product parameters meeting the general requirement (the 'N00' number) or are the SPSO designated external parameter numbers for that parameter. Readers are refereed to table T-5 of the SPSO output of February 1994. The options outlined represent ECS' best understanding at the time of issue

The following assumptions are relevant:

- the sections in the instrument chapters are based around the 'N00' labeled coded data dependencies as supplied by SPSO and are taken to represent data requirements
- requirements for external data sets present more interface difficulties and the data sets are less well defined (and are consequently discussed in more detail).
- many 'external' or non-EOS requirements can be met optionally by EOS products

Further discussion and analysis, involving instrument teams and the NASA project should then lead to the development of:

- conclusions concerning optimal sources from a system and science point of view
- an outline of the ingestion route and the functionality necessary to make the data set available in each case

Appendices A through H contain instrument specific information concentrating on understanding and analyzing the current requirements as expressed through the SPSO tables and directly to the study team. This is done is the form of notes and comments of the sources and the implications for the ECS. The instrument orientation is necessary to allow the analysis of requirements relevant to an instrument teams.

The analysis in Chapter 2 relies on ancillary data information collated and sorted to show how requirements can be mapped to specific data sets. The discussion notes in the instrument chapters provide the background to the mapping. This view allows the identification of common data sets and their source and destination allowing conclusions to be developed.

1.4 Study Development

In this first version, many of the data sets are speculative matches to requirements and there is a degree of overlap and inconsistency. Further work over the next 6 months is planned to clarify policy at a detailed level. In addition more effort is required to gather details of non-EOS ancillary data sets and their source characteristics. These efforts should enable an update to fully specify all aspects of ancillary data handling.

2. General Conclusions

2.1 Introduction

The comments and discussions in appendices have been reflected, as far as possible, in the development of a set of tables (Appendix I) showing specific inputs satisfying the ancillary data requirements of the various teams. A tool outlined in the introduction has been used to trace dependencies from each product to an end point being one of :

- an EOS product was reached other than from the instrument being analyzed
- the level 0 product was reached
- a non-EOS product was reached

For example for CER08:

CER08 depends on CER07

CER07 depends on CER10 & N0079

CER10 depends on CER05 & N0076

N0079 consists of a number of data sets would could be satisifed by:

Requirement	Possible dependency
Land Type, Sfc	Land Type, Sfc
Snow Type, Sfc	MIM18
Snow Type, Sfc	MIM22
Snow Type, Sfc	MIM23
Snow Type, Sfc	SSMI_SNOW
Snow Type, Sfc	SNOW2
Snow Type, Sfc	TJZN01
Vegetation	TJTG01
Vegetation	Ecosystem CD-ROM
Albedo, Visible, SURFMAP	Albedo, Visible, SURFMAP
Sea-ice Type, Sfc	AVHRR_ICE
Water Type, Sfc	Water Type, Sfc

CER05 depends on CER04

N0076 could be satisfied by etc.

CER04 depends on CER11 &etc.

CER11 depends on MOD02 & etc.

etc.

This creates paths (links between ancillary inputs and dependent products) such as:

non CERES EOS product - MOD02 > CER11 > CER04 > CER05 > CER10 > CER07 > CER08

non-EOS product - SSMI_SNOW > N0079 > CER07 > CER08

etc.

When repeated for all products, this process yields a large number of paths between the product and it's dependencies.

Note that 'dependency' here specifically excludes products from the same instrument being classed as dependencies. In this sense the ancillary data inputs rather than strictly the dependencies were identified.

The total number of paths turns out to be around 2000. However, the number of unique dependencies is only 205. On average each dependency has 10 paths to various products. This is due a number of factors:

A the same dependency can be traced to many products across different instruments

B the same dependency can be traced to many products from the same instrument

C the same dependency can be traced to the same product by several paths

D dependencies which may not be available for certain periods (e.g. AIRS) but are included in the aggregate

Note also that:

- some dependencies (both EOS and non-EOS) meet the same requirement.
- the same input product provides for several dependencies (e.g. NMC products meeting requirements for pressure, temperature etc.) thus artificially inflating the number of paths.

For the purposes of understanding the effects of the ancillary data inputs on elements of the PGS, these larger tables have been paired down by removing the multiplying effects of factors A, B and C. By this means, it is possible to collate specific identified inputs at an instrument level. Tables A and B in appendix I show the resulting set of ancillary data set inputs.

The tables shows the ancillary inputs identified as meeting the general requirements created by the processing of each instrument. The specific inputs are one of an EOS product (as given by SPSO) or a non-EOS product identified during the study. Where no specific input could be identified, the detailed requirement is entered in the shaded 'Input' column. The column labeled

'parent' is either the EOS product or N00 requirement number associated with the requirement. Where a requirement is 'fixed', this shows that the input is an EOS product identified in the SPSO coded dependency column. In these cases, the nature of the requirement is given by the product name. The remaining columns to the right of the shaded input column contains details of the input.

Table A is sorted by instrument and parent to show how the study has sought to resolve requirements with inputs. Table B is sorted by source DAAC/ADC and input. This table is used to develop toolkit and pre-processing conclusions.

It should be noted that the tables contain the fullest number of possible inputs and as such they represent what ECS regards as the full list, from which it is likely that ancillary inputs will be dropped rather than added to.

2.2 Analysis of Tables

Table B contains 270 rows. These represent identified ancillary inputs unique to the instrument. It include some speculative inputs and a number of unidentified inputs known only by their detailed requirement. There are a number of instances where the same input is repeated but in each case a different instrument or requirement is served. The number of unique inputs (regardless of instrument or requirement) is approximately 200. The effects of repeated inputs is not overwhelming and in fact serves to emphasize those inputs of particular importance. Simple classification of the attributes of the rows shows the following:

- there are 56 fixed inputs (EOS products identified in the coded dependencies from SPSO)
- there are 94 EOS products including the fixed inputs. The additional 38 products are possible inputs to meet 'non-EOS' or N00 requirements.
- there are 175 non-EOS inputs
- in terms of data set coverage, some 71 are 3-dimensional and 190 2-dimensional. The remainder are profile or 1 dimensional type data set (e.g. radiosonde).
- in terms of horizontal data representation, 104 inputs are organized in 'kilometer' cells (e.g. 5x5km) while 41 are based in terms of latitude/longitude. There is no information for the remainder.
- few inputs are static[1] , although the DEM and land/sea flag inputs are repeated frequently.
- the majority change dynamically with rates of change (where available) :
    - monthly 8
    - weekly 8
    - daily 84
    - hourly 32

1 Static data sets contain values which change unpredictably or not at all.

- of the identified format types, GRIB format (NMC) are 8, BUFR (NMC) 6 and HDF (EOS products) 94. Most of the NESDIS products (40) are known to have a single or very similar low level binary format.
- overall numbers of inputs (including potential and alternate) for each instrument are:
  - LIS 27
  - CERES 55
  - MODIS 59
  - MISER 29
  - ASTER 26
  - MOPITT 35
  - AIRS 38
- the sources of inputs which have been identified show the following:

  DAACs

  - LaRC 19
  - MSFC 10
  - NSIDC 7
  - GSFC 65
  - EDC 10

  ADCs **(see section 2.5)**

  - TSDIS 4
  - NWS/NMC 13
  - NESDIS 43
  - METEOSAT/EuMetSat 2
  - JIC 2
  - 'Japan' 6
  - ECMWF 14
  - ESRIN 2

2.3 Implications for PGS Toolkit

The analysis gives a clear indication of the nature of ancillary data inputs with which the toolkit must deal. Clearly both HDF and a range of non-EOS formats must be dealt with, although the 3 identified NOAA formats (GRIB, BUFR, NESDIS binary) cover many of these. Most data sets are gridded, particularly in 'km' arrangements and many are 2-dimensional. The 3-dimensional data sets are almost exclusively from NMC, or the alternates ECMWF, GSFC/DAO and FNMOC (the latter is not specifically identified in tables).

Some of the surface data layers (e.g., land cover) that instrument teams require may also have a 3-dimensional aspect to them as well as a somewhat dynamic nature. Both of these need further investigation.

The toolkit must be able to provide useful 'value added' service to efficiently access these data sets. Generic 2 and 3-dimensional tools have been proposed to give access by lat/long or by a reference to the structure of the data set in terms of columns and rows. However many of the gridded 'km' type data sets are EOS products having no fixed baseline; i.e. they are dynamic in spatial terms. Access to these using lat/long could involve a heavy investment in searching data products. In addition, these same inputs are spatially limited and will frequently need aggregating to cover the input requirement (see 2.4). Even when aggregated, the selection of these products through the toolkit interface may be difficult given that the attributes and search criteria vary. These are serious challenges to the toolkit.

Table B is sorted by input and thus shows where specific ancillary inputs are required to meet several requirements. Several of these data sets are already being developed by ECS; namely the DCW_LND_SEA input which is being used in the PGS_AA_DCW tool to provide land-sea flagging. Similarly, the PGS_AA_2D tools will be tested using the Ecosystem_CD_ROM. Other notable static data sets are the DCW_Global_DEM. This product is being developed at EDC, but is not yet released. Similarly, the DMW_DTED products are not fully available. For these reasons, ECS cannot pursue these data sets. Of the many dynamic data sets, the EOS products should be accessible through the generic 2D and 3D tools as should the NESDIS products. For the latter, it is currently assumed that all NESDIS products are available throughout the period of the EOS mission.

The use of the toolkit will most likely vary between teams. For example, MODIS Science Data Support Team (SDST) intends to implement a combination of PGS Toolkit and their own SDST Toolkit Routines in accessing and using Orbital masks of a DEM in their standard processing. There is also a discussion in the MODIS section of the use of heritage code for NMC access (from the SEAWiFS project). Both of these must be investigated further, and their potential use in ECS work considered. More detailed comments are found in conclusions to individual appendices.

2.4 Implications for PGS Pre-processing

The pre-processing of inputs is necessary on a routine basis to facilitate the preparation of dynamic data sets for use by instrument chains. Checking and reformatting (FM) of incoming

data sets is clearly a requirement for all non-EOS data sets. The format to which these data sets must be put is being defined by the toolkit work; but is likely to be a simple byte level packed binary which is currently termed 'binary access format'. Pre-processing of input data into binary access format will be crucial, particularly in the cases where an input requirement may be met by a variety of data sources. Considering the vastly differing spatial and temporal coverage of many data sources, care must be taken in order to ensure that any change to a backup ancillary source will be as transparent as possible to the processing string.

Many NOAA data sets are gridded on a global basis and can be accessed relatively simply after this. However, it is also clear that the large number of EOS products, all of which have limited spatial coverage will need further preparation in terms of:

- subsetting of specific parameters; preferably at the 'home' DAAC to reduce volume (ST)
- aggregation of several products into one (AG) or further spatial sub-sampling (SP)

Table C has the input rows with additional columns showing the tool which might be used to interface the input to algorithms, the likely pre-processing steps (using FM, ST etc.) and an assessment of the priority (High, Medium, Low) of developing the pre-processing. In general a high priority is given to external source pre-processing (especially reformatting) for TRMM and AM instruments. A medium or low priority is given to the subletting of EOS products. This reflects the fact not that EOS products are unimportant or few (quite the opposite) but that the subsetting/sub sampling/aggregation functions are similar to the user data type services which allow users to request sub sampling etc. of products. These services may be developed as part of the data type services within the Data Server subsystem. However, it is likely that the pre-processing of EOS products for ancillary use will need more functionality than that required by users and consequently specialized data type service functions may be required to deal with these. It is not yet possible to specify these services since there is a strong interaction with instrument team developments; i.e. the pre-processing of EOS products to serve as ancillary data inputs cannot be defined until the EOS products themselves are more fully specified; for example, the use of level 1b MODIS product in CERES processing for cloud masking. ECS may have to deal with several such instances.

Table C also maps inputs to sections in this report.

In conclusion, it is proposed that the following pre-processing be implemented initially by ECS as specialized data type services for ancillary data preparation:

- reformatting of NMC GRIB formatted products to binary access format. These are assumed to be available through a single NMC interface.
- reformatting of NESDIS operational products to binary access format in so far that they are supplied in standard 'NESDIS binary' format and are available through a single SAA interface.
- reformatting of NMC BUFR products. These are assumed to be available through a single NMC interface.

If the conclusions presented above are compared to the original requirements for pre-processing implied by table C-6 of the Requirements Specification (Feb '93), significant differences are

found; table C-6 cites non-EOS sources/products as AVHRR L1B and L2, ECMWF data, FNOC data, GOES L1B, GOMR L1B and NMC data. Of these only NMC and AVHRR L2 (NESDIS product) have been clearly identified in this report.

Other dynamic non-EOS products identified in this report are currently insufficiently firm in terms of requirement status to warrant the commitment of resources (hence low priority). Where pre-processing is noted as 'none' this implies the input is static and does not require routine pre-processing. However, these data sets will be pre-processed by ECS in so far as they are available (a one-time effort) and supplied with tools .

2.5 Implications for ECS Interfaces

This report seeks to identify all potential sources for ancillary data, and thus all potential ADCs. So far, only one ADC has been formally identified by the ESDIS Project: NOAA (shown as NESDIS and NWS/NMC) . This report indicates the potential need for additional ADCs.

Additional ADCs imply additional external interfaces, and therefore additional cost. The necessity of these additional ADCs must be weighed against their cost; for example, some of the potential ADCs have been identified as sources for back-up data only.

A cost-benefit analysis is underway within the NASA DPFT ancillary data study group. This study will establish the baseline list of required ancillary data sets, and thus any additional ADCs, for inclusion in the ECS baseline; this list will be finalized by the ECS PDR.

The tables show that the majority of inputs come from the NOAA ADC(s). The other potential ADCs provide inputs which are the more speculative in this report and the need for interfaces is unclear; the current understanding of these is:

TSDIS

TSDIS may provide a number of ground truth products of use to LIS, but their ancillary status is not clear. The interface may be via GSFC (see B.05).

METEOSAT/EuMetSat

METEOSAT images may be required by LIS on a correlative/ancillary basis.

JIC

The Joint Ice Center; this is a NOAA/Navy center whose products are required as ancillary inputs. However, the interface is unclear; it could be via a NOAA site or may be through the NSIDC DAAC since the NSIDC has recently taken a role in JIC.

'Japan'

ADEOS1 is cited as potentially providing several input ancillary products. The most important of these is the TOMS ozone data set. While the platform is Japanese, it is not known where the products will be produced, but this might well be at GSFC thus negating the need for a ECS-Japanese interface.

ECMWF

ECMWF appears to be a serious contender as an additional ADC. In many cases, ECMWF products are quoted as backup to NMC. However, both LIS and MISR have requested ECMWF products are primary inputs on the basis that certain ECMWF products are superior to the NMC equivalents. This issue needs urgent attention. It should also be noted that FNMOC (Fleet Numerical) produces products similar to those of both NMC and ECMWF. Some mention has been made of this source by the MODIS team.

ESRIN

This European source has been quoted as supplying aerosol from the envisage mission. These requirements appear to be speculative. However, it should be noted that there is little knowledge of the products and it is possible that further requirements for ESA products (EnviSat or MetOp) may emerge necessitating the serious consideration of a European interface.

In addition, MODIS Ocean Team members require buoy data from many different NOAA Centers and from international government agencies (e.g., Canadian Maritime Agencies). These data will be used to validate higher level products and the calibration of MODIS Level 1B Radiances. In the first year following the launch of AM-1, these efforts will probably be done at the SCFs of these investigators, but there is a desire to move this effort to the DAACs and have it done in an operational environment after the techniques are refined and more automated. Thus, interfaces to these agencies must be developed with the timing of implementing them TBD.

2.6 ESDIS Action

A number of issues arise from this study which indicate the need for the ESDIS project to provide policy direction to ECS.

Firstly, consider the role of ECS in pre-processing software and provide technical direction as to how to proceed with the well defined data requirements.

Secondly, while the study has begun to characterize the toolkit and ancillary data pre-processing requirements in detail as well as providing background to ADC interfaces; it remains necessary for ESDIS to coordinate with the DPFT to:

- clarify through the SPSO tables, the priority to be given to each input ancillary product; i.e. which is principal and which backup.
- provide a policy concerning the level of development which should be applied in supporting backup sources.

There are two related issues which should be included in the analysis.

a) While the issue of test data is being addressed within ESDIS, it is not yet clear what level of support ECS need offer. During Algorithm Integration and Test it is critical that science team developments be compatible with interfaces, ancillary data toolkit and pre-processing being developed by ECS; i.e. that development of ancillary ingestion currently underway at SCFs not

be at variance with the ECS implementation. The immediate question is which group provides each test data set and to what level should they be prepared.

b) A further issue is that of how reprocessing might effect ECS ingestion. New or alternate ancillary data sets may encourage reprocessing. While a fixed interface may be unnecessary (timeliness is not critical; media transfer may be adequate) the pre-processing and toolkit access for the new data set requires attention. In particular, it appears likely that non-EOS sources may frequently be swapped for EOS products for reprocessing. The use of EOS products as ancillary inputs presents non-trivial problems in toolkit product selection and any pre-processing as discussed above.

Appendix A CERES

A.01 Introduction

CERES instrument processing is highly dependent on ancillary data inputs. The CERES team has given consideration to the issues arising from this dependence and is developing an IRD to specify requirements. ECS has been involved in this process from a technical standpoint. Some policy issues remain outstanding.

Figure 1 is based on the CERES ATBD and shows outline relationships between products and ancillary inputs. The following sections discuss the various sources of the ancillary data; sections relate as labeled in figure 1. The information is derived from the SPSO tables, early drafts of the CERES IRD, the CERES ATBD and a draft CERES data product catalogue. Some additional sources have been added where appropriate in order to present a wider range of options and fill gaps. However, the majority of source are those suggested by the CERES teams themselves in one or other document. Note, the input labeled 'EPHANC' is not covered. This is the platform ephemeris data.

The discussion focuses on the potential role of the PGS toolkit both I/O tools and ancillary data handling. There are also implications for pre-processing as well as comments on source availability and recommendations for ECS as to which sources should be supported. A number of tables support the text. These tables specify products some of which are derived from SPSO and CERES team requirements but many of which have been inferred from those requirements. This allows detailed comparisons of source attributes to be compared.

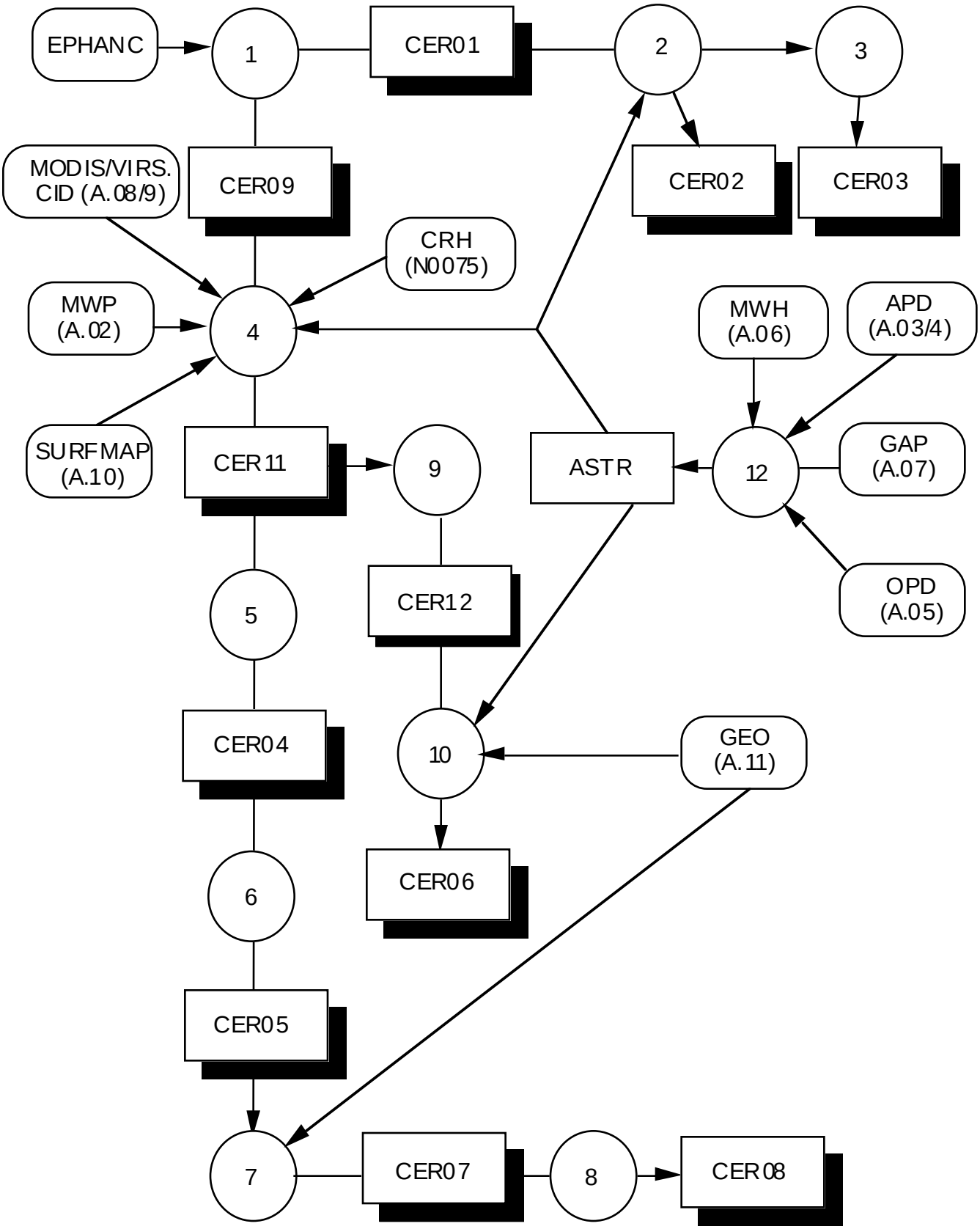


Figure 1 Outline CERES Products, Processes and Ancillary Inputs

A.02 Microwave Liquid Water Path : MWP : Cloud WG

A.02.1 Introduction

Used in process 5 to support CER11 and consequently other products up to CER08 and CER06 (not required for CER03 branch of the processing). SPSO external option N0077.

A.02.2 Source and Source Data set Attributes

Input	2A-12	MIM03	MIM14	SSMI_PRECIP	TCGN05
parm #	878	3598	3598a	878	878
Parm/Product Name	Surf. Rain rate + profiles	Oceanic Cloud Water	Gridded Oceanic Cloud Water	Total precipitable water (navy alg.)	Total precipitable water
Instrument	TMI	MIMR	MIMR	SSM/I	MSI
Platform	TRMM	PM	PM	DMSP	GOES
DAAC/ADC	MSFC	MSFC	MSFC	NESDIS	NESDIS
from	Aug-1997	Dec-2000	Dec-2000	Jan-1990	Jan-1990
to	Jul-2000	Jun-2006	Jun-2006	Jan-2010	Jan-2010
GB/day	6.205	0.0050	0.0001	?	?
Units	?	mg/cm^2	mg/cm^2	?	?
Accuracy (Abs:Rel)	?	3 mg/cm^2	1 mg/cm^2	?	?
Temporal Res.	?	1/day	1/day	6 hours	?
Horizontal Res:Cover	20km::	14km ::Ocean	1.0 deg ::	25km:orbital swaths	14km:N America
Vertical Res:Cover	?	N/A :: Trop	N/A :: Trop	n/a	n/a

The source for TRMM CERES instruments is TRMM TMI product available from TSDIS at MSFC. It is not clear which product refereed to; possibly 2a-12 TMI rainfall structure (need full product specs).

The preliminary source for EOS-AM CERES is the MIMR instrument on ESA's MetOp.

The source for EOS-PM is MIMR flown on EOS-PM.

It is assumed the MetOp and PM MIMRs will be the same instrument, processed to the same products in Europe and the US. In the latter case the product is MIM14; although it could be MIM03 which is the swath based version of the same parameter.

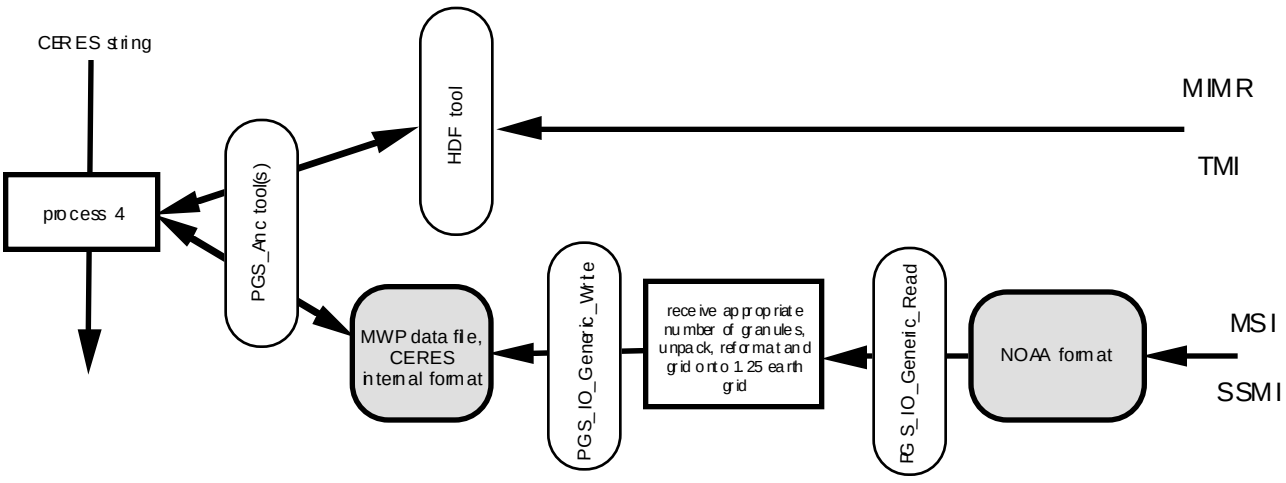
CERES IRD quotes this source as of medium importance.

A.02.3 Interface to Processing

All inputs to process 4 in the CERES scheme (Determine cloud properties TOA and Surface Flux). The MWP data structure outlined by the CERES team uses the pixel level structure of the input products. However, a 1.25 ISCCP like grid could also be used although this applies only to products from instruments on other platforms - i.e. for the major sources, the CERES team expects to use level 2 products direct. The CERES team has indicated that the preparation of the TMI and MIMR products would be part of their operations in process 4. The preparation will change between TMI and MIMR, although it is likely that the preparation will have a similar flavor.

Where the source is HDF formatted (as can be assumed for TMI and MIMR), then suitable PGS_IO_HDF tools should allow the anc. tool access to the data. We can also assume that the specified parameter from TMI product have been extracted using generic services at the supplying DAAC.

For the other sources (if used), addition processing is required, which should be supplied by the CERES team. The PGS tool required are as shown below. The preparation function does all the necessary reformatting, rebinning and collation of the appropriate number of input products (e.g. 14 orbit based level 2 products per day). We also assume that process 4 has functionality included to locate the area of earth grid required by the processing and will use the ancillary access tool(s) in this way (e.g. called either by lat/long or data structure).



A.02.4 Ingestion Route

TMI products being produced by TSDIS and archived at the MSFC DAAC. It is expected that level 0 deliveries are daily thus output of products is daily. Assuming transfer time to MSFC DAAC is negligible then TMI should be available at MSFC for access by LaRC also within c. 24 hours of sensing. Direct transfer from TSDIS to LaRC could be conceived but is not in the current TRMM interface document. The DAAC to DAAC transfer seems most likely.

Euro-MIMR route maybe from Europe where it is to be processed, exactly where in Europe or by what means transfer to LaRC is achieved is unknown. If this becomes a serious option, then timely ingestion could become a major problem.

A.02.5 Verification

MIMR products have only 1 parameter and should not require further verification or metadata extraction; only the use of existing metadata.

TMI products may need subletting but little further verification.

SSM/I and MSI products will need verification and possible metadata generation. Transformation to the 1.25 degree ISCCP grid should ideally occur in ingest and be combined with verification.

A.02.6. Group Responsible for Development

The CERES team has stated that they will deal with the incoming TMI and MIMR as described above.

A.02.7 Temporal Availability and Source Security

Operational TRMM products will not be available until 6 months after launch. This leaves a serious hole in CERES processing for this period. Solutions are that :

- TMI product could be released early
- CERES processing is left incomplete for the same period (impact TBD)
- use backup source

Availability of MIMR will depend in the first instance on MetOp launch, and subsequent ground segment performance. Launch is not yet fixed but maybe around 2000 ch is the same as PM anyway. **There appears to be no support for EOS-AM(1998-2000); MIMR and TMI have insufficient coverage**. This also raises a risk element since TMI is not under EOSDIS control. The European MIMR has nothing to offer in terms of covering the gap. It would therefore be advisable to have the backup in place. This should perhaps be extended to TRMM also due to the potential absence of TMI during the first 6 months.

Another aspect of TMI restriction is that liquid water is produced only over the oceans. It is not clear whether any sensor produces over the land (TBC).

A.02.8 Backup source

The backup sources are MSI and SSM/I. These is should be available on an ongoing basis from NOAA/NESDIS. The products from NESDIS are probably those shown in the table above. Due to the established nature of MSI and SSMI/I processing and the relative stability of their products as compared to TMI and MIMR, it advised that one or both backups be a high priority for development; in particular due to the lack of other support for EOS-AM1.

A.02.9. Schedule for Source, Ingestion Route and Associated Developments

The tools for basic non-HDF read/write should be available by Fall '94. The preparation procedures for TMI and MIMR will have to wait on detailed information on product formats for these instruments. A tool to produce a 1.25 degree ISCCP gridded product is common to many CERES inputs. This appears to fall to the CERES team as a instrument specific pre-processing step.

A.02.11 Testing

MSI and SSM/I data will be required for test purposes in the relatively short term (1-2 years). SSM/I will be available at the MSFC DAAC as a pathfinder data set or from NESDIS itself. This should clearly be used for testing given it's importance as a backup.

A.03 Aerosol (optical depth - troposphere) : APD : SARB WG

A.03.1 Introduction

Input to ASTR internal data file via process 4. SPSO external option N0037. Used as input to CER11 (and therefore 8 and 6). See also A.04 (thin stratospheric aerosol).

A.03.2 Source and Source Data set Attributes

Input	MOD04	TKTG02	1b-01	MIS05
parm #	2293	916	916	2299
Parm/Product Name	Aerosol Product	Aerosol global analyzed field	VIRS Level 1B	Aerosol Product
Other name	Aerosol Optical Depth, Spectral		-	Aerosol Optical Depth
Instrument	MODIS	AVHRR	VIRS	MISR
Platform	AM,PM	POES	TRMM	AM
DAAC/ADC	GSFC	NESDIS	TSDIS	LaRC
from	Jun-1998	Jan-1990	Aug-1997	Jun-1998
to	Oct-2008	Jan-2010	Jul-2000	May-2003
GB/day	1.52	0.000205048	0.706	3.4
Units	dimensionless	optical depth units	?	dimensionless
Accuracy (Abs:Rel)	0.05 :: 0.02 (Ocean) 0.1 :: 0.04 (Land)	0.03-0.05 ODU	?	0.05 (t≤0.5)/10% (t>0.5) ::
Temporal Res.	1/day	weekly	?	1/(2-9 day) [d]
Horizontal Res:Cover	50 x 50 km :: Land; 5 x 5 km :: Ocean	1x1 degree::global (70N-70S)	?	17.6 km (L), A.2 km (O) :: G
Vertical Res:Cover	N/A :: Atmos	N/A:: Atmos	?	Column:: Atmos

Principally VIRS and MODIS. The VIRS product is unclear, optical depth is not an official output from VIRS. The level 1b is the obvious candidate since there is currently no other VIRS product which could provide suitable physical parameters (n.b. the VIRS.CID in section A.08 utilizes this same product as input). MODIS is the preferred source. However, it is obviously unavailable for the first year of TRMM flight. Latest indications from CERES group are that

Larry Stowe (NOAA) will provide an algorithm to CERES for use with the VIRS product. If VIRS is not used then the AVHRR product may be used which are based on the same Stowe algorithm.

MISR produces opacity, single scattering albedo and the phase function. This is seen both as backup and additional to the VIRS/MODIS inputs.

CERES IRD quotes this source as of medium importance.

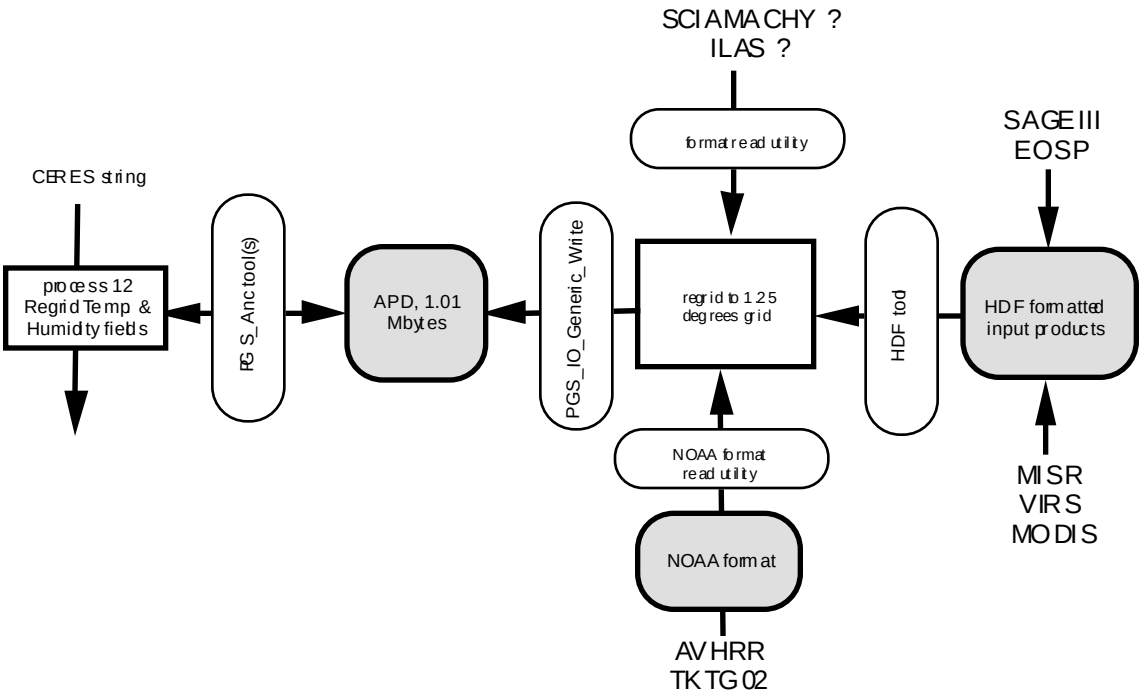
A.03.3 Interface to Processing

The APD file described in CERES catalog document contains both types of aerosol (thick and thin). It is not clear which levels are to be provided for from each source. The requirement for a daily, global equal area gridded product implies considerable preparation of the VIRS, MODIS and MISR products since each of these is in swath based format.

The preparation is also as described in section A.04.

The preparation function will cover both types of aerosol.

The regrid function may be part of process 12. If this is so, then a strategy is required to deal with changing source formats. The PGS_Anc tool may be useful here.



A.03.4 Ingestion Route

Ingestion of VIRS product as in section 2.08.4. Ingestion of the MODIS product is TBD, but in any event will be from GSFC DAAC. MISR is to be processed at LaRC DAAC, for which reason and to reduce dependency on MODIS, use of MIS05 might become more important.

AVHRR products should be available through the SAA.

A.03.5 Verification

The AVHRR product will need verification and deformatting, probably before archive. The EOS products both require sub-setting due to relatively large volume.

A.03.6. Group Responsible for Development

The preparation of these incoming data could be a significant element in CERES processing. The development will be of a similar size to the reformat function identified by the CERES team and discussed in section A.08.6.

A.03.7 Temporal Availability and Source Security

MISR and MODIS products should be available for AM CERES processing. The fact that there are 2 similar inputs available within the DAAC system should mean that the input is secure. For TRMM CERES processing however, the uncertainty over the content and availability (first 6 months) of VIRS products means more risk.

A.03.8 Backup source

MISR as backup for AM already discussed. TRMM CERES backup is cited as AVHRR.

A.03.9. Schedule for Source, Ingestion Route and Associated Developments

it seems likely that process 12 will cover all pre-processing.

A.03.11 Testing

Could use AVHRR products (operational or pathfinder) or SAGEII products - all are readily available.

A.04 Aerosol ('thin' stratospheric) : APD : SARB WG

A.04.1 Introduction

Input to ASTR internal data file from APD file. Used as input to CER11 (and therefore 8 and. Combined with column aerosol. SPSO external reference N0038.

A.04.2 Source and Source Data set Attributes

Input	SAG02	EOS3	ILAS_AER	POAM_AER	SCIA_AER
parm #	1012	2297	917	917	917
Parm/Product Name	Aerosol Extinction Profiles (at 7 wavelengths)	Aerosol Optical Thickness	Aerosol	aerosol	aerosol
Other name	Aerosol Extinction Profiles (at 7 wavelengths)	Aerosol Optical Thickness	0		0
Instrument	SAGE-III	EOSP	ILAS	POAMIII	SCIAMACHY
Platform	AERO,CHEM	AM2	ADEOSI	NRL	envisage
DAAC/ADC	LaRC	LaRC	Japan	?	ESRIN
from	Jun-2002	Jun-2002	Jan-1996	Jan-1996	Jan-1998
to	Nov-2007	Nov-2007	Jan-1999	?	Jan-2001
GB/day	0.0004	0.016	?	?	?
Units	/km	dimensionless	?	?	?
Accuracy (Abs:Rel)	5% :: 5%	0.05 :: 10%	?	?	?
Temporal Res.	1/(2 min), 30/day	1/day [d]	?	?	?
Horizontal Res:Cover	<2 x <1 dg :: G	40 km :: G	?	?	?
Vertical Res:Cover	1 km :: 0-40 km	Column :: Atmos	4km::?	?	?

Primary sources are SAGEII and SAGEIII. SAGEII is currently operational as a NASA provided instrument on a NOAA platform (ERBS). It is cited as serving the TRMM and EOS-AM missions until the launch of SAGEIII. However, SAGEII is currently beyond it's life expectancy and will not last until 1997. Is there another SAGEII ? if not another source will have to be identified for APD (thin) to cover the period 1997-2000.

Little is known about the Japanese and European sources although they potentially cover the period required. If this is a critical input and the sources in A.03 do not cover the input, then consideration may have to be given to these non-US sources.

CERES draft IRD also quotes POAMIII (SPOTIII) as a source. No information.

EOSP could be seen as a further backup.

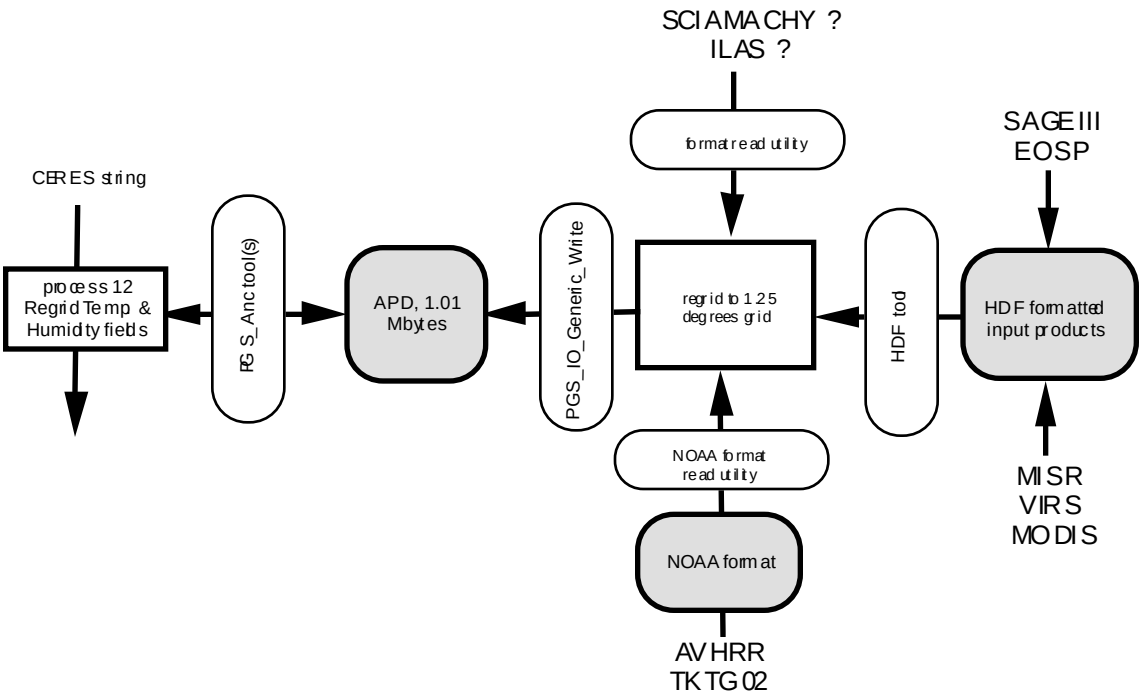
CERES IRD quotes this source as of medium importance.

A.04.5 Interface to Processing

The data are required as input to process 12 of the CERES system 'Regrid Humidity and Temperatures Fields'. The process requires a daily global coverage in 5 atmospheric levels in 1.25 degree grid cells and with an associated region number; daily volume 1.01 Mbytes. The 3 PGS tools required interface between the preparation PGS and the files.

Incoming SAGEIII (or backup) product must be regridded to 1.25 degree bins by the preparation PGE. Input bin size is 0.5 degrees which means that rebinning involves either location to nearest 1.25 cell center or some form of interpolation (e.g. bi-linear) for parameter values. Missing value rules are *TBD*.

The regrid function may be part of process 12. If this is so, then a strategy is required to deal with changing source formats. The PGS_Anc tool may be useful here.



A.04.4 Ingestion Route

Immediate access to SAGEIII products should be possible since it is archived at LaRC DAAC. Exact ingestion route will depend on local configuration of hardware which is a matter for the DAAC. The timeliness of arrival depends mostly on the production rate of SAGE rather than the delivery mechanism (TBC). **Should non-US sources be used, the ingestion mechanism would become a major issue.**

A.04.5 Verification

as A.03.5

A.04.6. Group Responsible for Development

ECS are responsible for development of the tools and verification. Process 12. is being developed by LESC. The preparation function should be developed by the CERES team since it is intimately connected to the requirements of the ASTR file (could be part of process 12 anyway).

A.04.7 Temporal Availability and Source Security

As noted above, SAGEII will not be able to service TRMM or EOS-AM, ILAS and SCIAMACHY as a backups suffer from being processed in Japan/Europe. No details of POAM_AER are available.

A.04.8 Backup source

ILAS (Improved Limb Atmospheric Sounder) on ADEOS and the SCIAMACHY instrument are potential backup. SCIAMACHY is unlikely to yield operational products for some time after launch (maybe 2 years); so unless ILAS can fill this gap, a problem remains. It is likely that the AVHRR product covering the column aerosol may well cover this requirement.

EOSP is a potential additional source.

A.04.9. Schedule for Source, Ingestion Route and Associated Developments

Some tools to read HDF files will be available by spring '94. Development of process 12 will be to CERES AI&T schedule. Development of preparation function is TBD.

A.04.10 Testing

The need for APD during development and AI&T should be serviceable from the current SAGEII archive. This is available now from LaRCIMS with products in native format. Ad-hoc reformatting or these products will probably be required although translation into HDF is anticipated. This would fall naturally to the local LaRC software team. The software developed for reformatting may form the basis of the preparation function although will it be written to a standard for routine processing ?

A.05 Ozone : OPD : SARB WG

A.05.1 Introduction

Ozone is input to the ASTR product (and thereby CER11 and all intermediate products to CER06 and CER08). SPSO external reference N0038. This section covers both stratospheric and column.

A.05.2 Source and Source Data set Attributes

Input	AIRS08	ILAS_OZONE	SAG07	TITG01	TOMS OZONE
parm #	3690	890	1321	890	891
Parm/Product Name	Ozone Product	Ozone	O3 Conc & Mixing Ratio	Level ozone (100, 70, 50, 30, 10, 5, 2, 1, 0.4 mb)	Column Ozone
Other name	O3 Conc		O3 Conc & Mixing Ratio, Solar		
Instrument	AIRS	ILAS	SAGE-III	SBUV/2	TOMS
Platform	PM	ADEOSI	AERO,CHEM	POES	ADEOSI
DAAC/ADC	GSFC	Japan	LaRC	NESDIS	Japan
from	Dec-2000	Jan-1996	Jun-2002	Jan-1990	Jan-1996
to	Jun-2006	Jan-1999	Nov-2007	Jan-2010	Jan-1999
GB/day	0.004	?	0.0007	?	?
Units	Dobson unit	?	Molecule/cc & ppmv	?	?
Accuracy (Abs:Rel)	20% :: 15%	?	6% :: 5 %	(+/-) 5%	?
Temporal Res.	2/day [d,n]	?	1/(2 min), 30/day	24 hours	?
Horizontal Res:Cover	50 x 50 km :: G	?	<2 x <1 dg :: G	200km:G	?
Vertical Res:Cover	4 levels :: Atmos	?	1 km :: 6-85 km	9 levels:?	?

Sources cited are SAGEII, SAGEIII and TOMS. SAGE details as section A.04.

TOMS is given as the primary source for column ozone. It is not known where this will be processed.

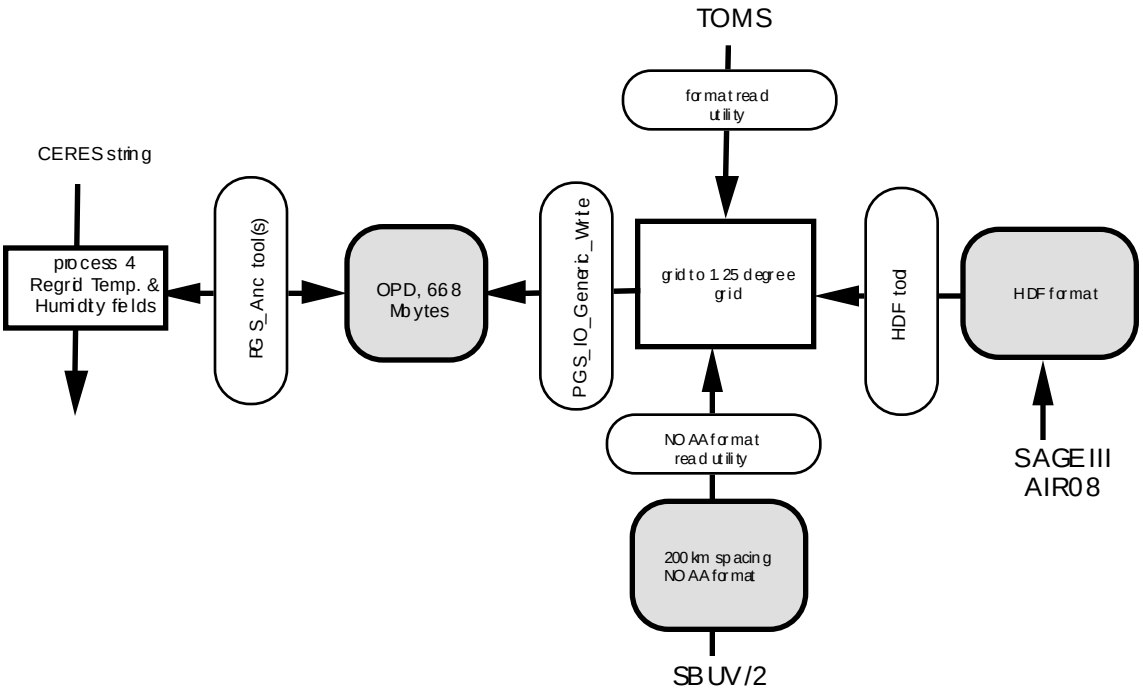
Use of AIRS not discussed by CERES team. ILAS details are unknown. HIRS is also cited as a column ozone provider - details unknown.

All sources cited as medium importance to processing.

A.05.3 Interface to Processing

As section A.04.3 with the exceptions that OPD file which inputs to process 12. is a daily, global 6.68 MB/day consisting 32 atmospheric levels. The preparation of this file is similar to that for APD (thin); i.e. into equal area bins and maybe covered by process 12. PGS tools will have the same function.

A SAGE2 based climatology could also be used. This would could be accessed directly from the PGS_Anc tool(s).



A.05.4 Ingestion Route

as section A.04.4. TOMS is currently processed at GSFC. It's status in relation to timeliness when flying on ADEOSI is unknown.

A.05.5 Verification

The EOS products may require sub-setting. TOMS and AVHRR products require checking and metadata extraction.

A.05.6. Group Responsible for Development

ECS are responsible for development of the tools and verification. Process 12. is being developed by LESC. Preparation function is similar to previously discussed; a single tool to bin to the ISCCP grid should be developed by the CERES team. This might be part of process 12.

A.05.7 Temporal Availability and Source Security

as section A.04.7. The availability of TOMS is unknown although continuing missions seem likely.

A.05.8 Backup source

Backup source is SBUV/2 on POES. Given the problem with SAGEII, this source must be developed as a backup and possibly prime source for TRMM and AM-1; especially to cover the stratospheric requirement.

SCIAMACHY produces ozone, also GOMOS and MIPAS all of which may fly on envisage. Of these, perhaps only MIPAS is likely to produce operational ozone products in the first years on envisage. GOMOS produces monthly products only.

The other major backup source could be AIRS although in a similar time frame to SAGEIII which is preferred.

A.05.9. Schedule for Source, Ingestion Route and Associated Developments

as section A.04.9

A.05.10 Testing

SAGEII and SBUV/2 are sources of test data . Advisable to investigate both given likely use of SBUV/2 (source life ?). SAGEII data comment as section A.04.10.

A.06 Microwave Humidity : MWH : SARB WG

A.06.1 Introduction

Input to ASTR via process 12 and thus to CER11. SPSO external reference N0036.

A.06.2 Source and Source Data set Attributes

Input	2A-12	AIR05	MIM15	SSMI_PRECIP	TCGN05	TCTG02
parm #	886	1869	3596a	886	886	886
Parm/Product Name	Surf. Rain rate + profiles	Humidity Product	Gridded Oceanic Water Vapor	Total precipitable water (navy alg.)	Total precipitable water	Layer precipitable water
Other name		Precipitable Water	Precipitable Water			
Instrument	TMI	AIRS	MIMR	SSM/I	MSI	HIRS/2, MSU
Platform	TRMM	PM	PM	DMSP	GOES	POES
DAAC/ADC	TSDIS	GSFC	MSFC	NESDIS	NESDIS	NESDIS
from	Aug-1997	Dec-2000	Dec-2000	Jan-1990	Jan-1990	Jan-1990
to	Jul-2000	Jun-2006	Jun-2006	Jan-2010	Jan-2010	Jan-2010
GB/day	6.205	0.0273	0.0001	?	?	0
Units	?	mm	g/cm^2	?	?	mm
Accuracy (Abs:Rel)	?	5% :: 3%	<0.1 g/cm^2 ::	?	n/a	(+/-) 30%
Temporal Res.	?	2/day [d,n]	1/day	6 hours	60 mins	110 mins
Horizontal Res:Cover	?	50 x 50 km :: G	1.0 deg ::	25km:orbital swaths	14km:N America	17km:orbital swath
Vertical Res:Cover	?	N/A :: Atmos	Column :: Trop	n/a	n/a	3 layers:?

Sources are similar to MWP (A.02) with TMI supporting TRMM1/2 CERES and MIMR on MetOp and PM supporting AM and PM CERES (note MIMR was previously on EnviSat but now on the later MetOp mission).

TMI - not clear which product refereed to; possibly 2a-12 TMI rainfall structure (need full product specs). Maybe same product as for MWP (section A.03).

MIMR - no product specs. yet available. It is assumed the MetOp and PM MIMRs will be the same instrument producing same products.

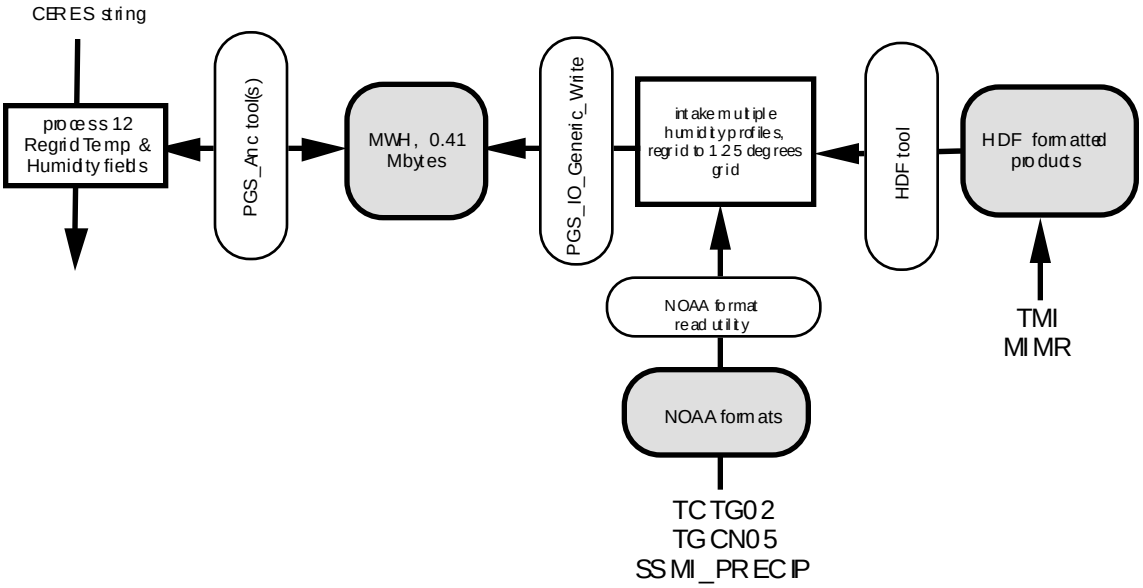
CERES DP team also quote MSI as a source; HIRS produces a similar product. Neither of these is microwave. The CERES science team favor SSMI product.

Dependency is of medium importance to processing.

A.06.3 Interface to Processing

The MWH product is ingested by process 1A. which reformats it for the ATSR internal product (as it does for APD, OPD and GAP). MWH format in CERES catalog is a daily, global file of 0.41 MB/day. This is unlikely to match the spec. of the incoming TMI or MIMR data. The preparation process required to produce this grid could be extensive (cf. APD and OPD interface processes), especially if the level 2 swath based products are used (use of gridded level 3 MIMR product would be preferable).

The PGS tools would be the minimal read write set; i.e. all reformatting functionality would reside in the preparation tool unless process 12. required the MWH file to be searched by geographic/time location translated by the tool.



A.06.4 Ingestion Route

TMI products being produced by TSDIS and archived at the MSFC DAAC. It is expected that level 0 deliveries are daily thus output of products is daily. Assuming transfer time to MSFC DAAC is negligible then TMI should be available in the MSFC DADS for access by LaRC DADS also within c. 24 hours of sensing. Direct transfer from TSDIS to LaRC could be

conceived but is not in the current TRMM interface document. The DAAC to DAAC transfer seems most likely.

MIMR route maybe from Europe where it is to be processed, exactly where in Europe or by what means transfer to LaRC is achieved is unknown. MIMR transfer from GSFC would be DAAC to DAAC.

All other options should be available through the SAA at NESDIS.

A.06.5 Verification

tbd

A.06.6. Group Responsible for Development

ECS are responsible for development of the tools and verification. Process 12. is being developed by LESC. Preparation function is TBD (depends on science content of rebinning), but being specialize to CERES, will probably be done by the CERES DPT as part of process 12.

A.06.7 Temporal Availability and Source Security

TMI and MetOp MIMR suffer from uncertainty being new instruments. TRMM-2 and PM platforms should be well served by these same sources once established. **However, AM-1 is NOT covered by any instrument.** The backup source is recommended for development both to cover the early TRMM and much of the AM missions.

A.06.8 Backup source

The source cited by the DPT is GOES MSI. This has the advantage of being an established operational source with a high temporal resolution; although disadvantages include low spatial resolution and limited coverage (mainly N America). Other backup sources are SSM/I and POES HIRS/2- and MSU. The former is the primary backup for MWP but has the limitation of ocean only coverage. The latter senses precipitable water over land.

The development of SSM/I as a backup source is commented on in section A.02.8. Development of this sources for routine ingestion from TRMM onwards should be considered.

A.06.9. Schedule for Source, Ingestion Route and Associated Developments

Some tools to read HDF files will be available by spring ‘94. Development of process 12. will be to CERES AI&T schedule.

A.06.10 Testing

GOES/MSI quoted as primary test source, however from above it is clear that SSM/I and MSU would be alternates.,

A.07 Gridded Analysis Product : GAP : SARB WG

A.07.1 Introduction

Input to ASTR file via process 12. SPSO external reference N0039.

A.07.2 Source and Source Data set Attributes

Input	AIR07	AST08	COM.CED 1.ANL.T0 xx.AVN	ECMWF_L ST	ECMWF_ MET	MOD11	MOD28	TDT G01
parm #	2481	3803	910	910	910	2484	2527	910
Parm/ Product Name	Temperatu re Product	Surface Kinetic Temperatu re	ANL	land surface temperatur e	met conditions	Land_sfc Temperatu re/Emissiv ity	Sea_sfc Temperatu re (SST)	Global SST observatio ns
Other name	Land_sfc Temperatu re, Skin	Land_sfc Temperatu re, Kinetic	CED1			Land_sfc Temperatu re	Sea_sfc Temperatu re (SST)	
Instrum't	AIRS	ASTER	0	n/a	n/a	MODIS	MODIS	AVHRR
Platform	PM	AM1	FNL	n/a	n/a	AM,PM	AM,PM	POES
DAAC/ ADC	GSFC	EDC	NWS	ECMWF	ECMWF	EDC	GSFC	NESDIS
from	Dec-2000	Jun-1998	Jan-1990	Jan-1990	Jan-1990	Jun-1998	Jun-1998	Jan-1990
to	Jun-2006	May-2003	Jan-2010	Jan-2010	Jan-2010	Oct-2008	Oct-2008	Jan-2010
GB/day	0.0634	2		?	?	2.67	95	?
Units	K	K		?	?	C	K	C
Accuracy (Abs: Rel)	1.0 K :: 0.5 K	1-4 K :: 0.3 K		?	?	1-4 C ::	0.3-0.5 K ::	(+/-) 0.5C
Temporal Res.	2/day [d,n]	1/(16 day)		?	?	1/day, 1/wk	1/day,1/ wk,1/mo	8 hours
Horizonta l Res: Cover	50 x 50 km :: Land	90 m :: Land/R,L		?	?	1 km :: Land/R	1 km :: Ocean/L	8km:orbita l swaths
Vertical Res: Cover	N/A :: Sfc	N/A :: Sfc		?	?	N/A :: Sfc	N/A :: Sfc	n/a

NMC given as primary source for these atmospheric parameters although ECMWF mentioned as backup for the surface parameters from the same source. Other potential sources and attributes are shown in the table.

The parameters required from NMC are temperature (inc. surface), humidity, wind and geopotential height. The file COM.CED1.ANL.T0xx.AVN is an example of an NMC analysis

field product from the aviation model, produced every 6 hours. It is not yet clear which of the NMC products actually meets the requirement. The other data sets in the above table are possible sources of surface temperature (land and sea).

High importance to processing (note the surface temperature products are separately noted as of high importance).

A.07.3 Interface to Processing

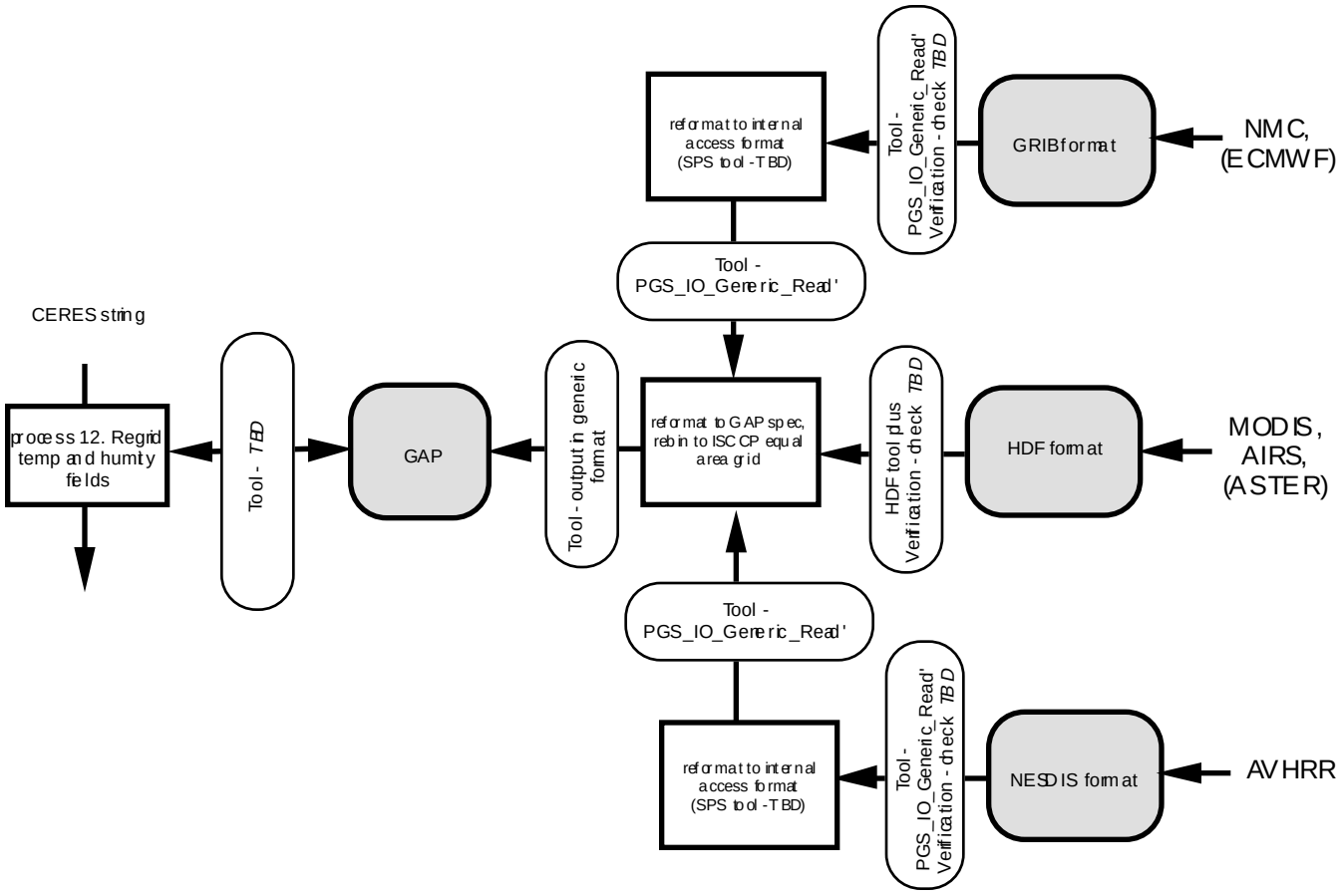
The NMC product will probably be prepared to a common access format by pre-processing. Incoming product spec. somewhat unknown although it is clear that the current grid spacing is 2.5 degrees in latitude and longitude (cells centered at 0 degrees in both planes). Required product is as GAP product specification in CERES catalog of 0.05 Gbytes per day; 1 day file, hourly, global coverage with 32 pressure levels in ISCCP 1.25 degree grid.

Incoming NMC not in ISCCP grid - rebinning and horizontal interpolation required.

The preparation function performs all formatting, therefore the tools need be only the simple read generic and write generic.

If sources other than NMC are used, then the preparation function will become much more complex and the ingest routines more numerous.

The reformatting to internal access format tools will almost certainly be ECS supplied. These are pre-processing steps, implicit in previous figures.



A.07.4 Ingestion Route

The ingestion route for NMC data is a major topic; it will probably be centralized for all DAACs at one point. Some sorting of products at this point will probably take place such that only those products required at each DAAC are transferred (TBD).

A.07.5 Verification

Routine QA of NMC data will be required; data checking for out of range values - rules required for replacing bad values (error values, interpolation etc.).

A.07.6. Group Responsible for Development

NMC data need to be prepared for several instrument. The preparation here appears to be very specific to the CERES GAP product. It remains to be seen if any of the preparation is common to other instruments; if this is the case, then common preparation should be taken on by ECS as part of SPS s/w; i.e. functionality moves from the reformat to GAP process to the reformat to access format processes.

A.07.7 Temporal Availability and Source Security

It is expected that NMC should produce routinely and reliably.

A.07.8 Backup source

The only obvious backup is ECMWF. The products are similar (information needed). There is a cost implication of ingesting this European source. **NASA guidance is required as input to decision to develop this backup source or not.**

Other sources noted in the table could provide high resolution inputs for specific parameters for limited periods. For example, if higher resolution sea surface temperature is required, then the AVHRR product could be used. In addition, EOS instrument products from MODIS and AIRS could be used for both sea and land surface temperatures. ASTER products could provide enhancement, although only for selected areas. A TMI product could possibly be used in the same way. However, with all of these higher resolution products, there is a major question over how the high resolution data could be incorporated into the preparation of the GAP product. This could entail a major preparation function.

A.07.9. Schedule for Source, Ingestion Route and Associated Developments

The preparation function could be a significant development, especially if common development (SPS) are involved covering several instruments. An early decision on the ingestion route for the program is required.

A.07.10 Testing

While NCDC archives observation data, it appears that the analysis and forecast grids are not archived (or only to a very limited degree). To obtain test data, some routine production would have to be captured. The DAO work currently captures 00z analysis and 00z and 12z forecast. This source might be used to provide test data sets for CERES processing.

A.08 Cloud Imager Data : MODIS.CID : Cloud WG

A.08.1 Introduction

Significant requirement to provide a cloud mask for CER11. Specific need for MOD02 content; see A.09 (VIRS) to provide similar. SPSO external reference for both CID products is N0074 although this should be regarded as a fixed input since it is the only cited possible input to satisfy this requirement.

A.08.2 Source and Source Data set Attributes

Input	MOD02(2338)
parm #	2338
Parm/Product Name	Level-1B Radiance, Calibrated Geolocated, MODIS
Other name	Level-1B Radiance, Calibrated Geolocated, MODIS
Instrument	MODIS
Platform	AM,PM
DAAC/ADC	GSFC
from	Jun-1998
to	Oct-2008
GB/day	500
Units	W/m^2/sr/μm
Accuracy (Abs:Rel)	5%(1∑) :: RMS<NEΔL
Temporal Res.	1/day
Horizontal Res:Cover	0.25 km, 0.5 km, 1 km :: G
Vertical Res:Cover	N/A :: N/A

The specific parameter is 2338 although this consists of a large number of channels only a subset of which are required. Of high importance to processing.

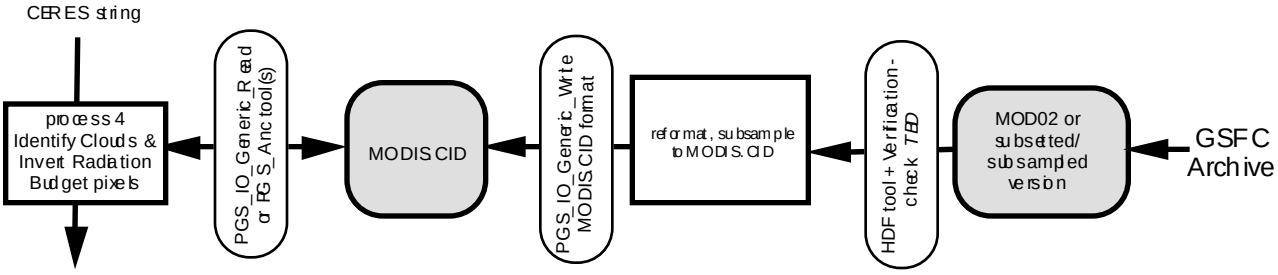
A.08.3 Interface to Processing

The interface is to process 4. of CERES processing via a reformat function identified by the CERES team. The CID.MODIS product specified CERES team contains 15 channels covering 1 hour of the satellite swath. 11 of these are direct from the MODIS product. The other 4 are created by

- averaging channel 1 (0.25 km) to produce a 0.5 and a 1.0 km versions
- averaging each of channels 6 and 7 (0.5km) to create a 1.0 km version.

The CID product is sized at 2.6 Gbytes per day, a dramatic reduction from the 500 Gbytes of the MODIS product **It is obviously critical that the subsetting of MODIS product in the CID version occurs at GSFC.**

In terms of PGS tools; only read HDF and read/write generic tools are required, although the Anc data access tool(s) could provide access by location (e.g. lat/long) if required.



A.08.4 Ingestion Route

These MODIS products are produced at GSFC; ingestion is from DAAC to DAAC. The key question is that given the very large size of MOD02 will preclude (or make very expensive) transfer of the whole of MOD02.

A.08.5 Verification

tbd

A.08.6. Group Responsible for Development

Subsetting of standard products should be available through standard ECS tools. The creation of the additional 'channels' by sampling is specific to CERES needs and should therefore be developed by the CERES team. Interaction with ECS required to determine logical and physical location of these functions.

A.08.7 Temporal Availability and Source Security

MODIS is sole source so security dependent on GSFC processing schedule. Should be available soon after launch.

A.08.8 Backup source

ISCCP is cited as a potential backup source. Details not known.

A.08.9. Schedule for Source, Ingestion Route and Associated Developments

Preparation has been considered by CERES team. Needs follow up in light of MODIS product development.

A.08.10 Testing

HIRS and AVHRR cited as potential sources for test data. Details TBD.

A.09 Cloud Imager Data : VIRS.CID : Cloud WG

A.09.1 Introduction

Significant requirement to provide a cloud mask for CER11. Specific need for VIRS content; see A.08 (MODIS) to provide similar. SPSO external reference given as N0074, although this is in effect a fixed input for CERES for the TRMM mission.

A.09.2 Source and Source Data set Attributes

Input	**1b-01**
parm #	?
Parm/Product Name	VIRS Level 1B
Other name	
Instrument	VIRS
Platform	TRMM
DAAC/ADC	TSDIS
from	Aug-1997
to	Jul-2000
GB/day	0.706
Units	?
Accuracy (Abs:Rel)	?
Temporal Res.	?
Horizontal Res:Cover	?
Vertical Res:Cover	?

This cloud imager data has TRMM VIRS as it's fixed source. Only the 1b-01 radiance product can fill the requirements apparent in CID.VIRS specification and process 4.

MODIS ID provides the same basic data for AM and PM platforms.

There is a need for further information. It is assumed that EOSDIS standard format will be used.

A.09.3 Interface to Processing

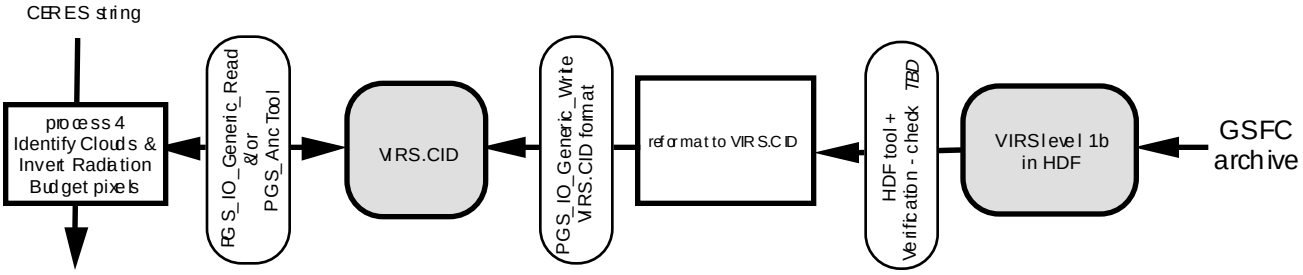
VIRS level 1b enters CERES processing via a reformatting process identified but not defined in CERES processing. The CERES defined CID product is 75Mbytes per day. This is significantly smaller than the incoming product. Once reformatted to VIRS.CID, it enters process 4. The format required is 1 hour long in time, swath based having 5 channels. The description in the CERES data catalogue document implies that the detailed format/binning etc. is not changed significantly from the VIRS product (TBC). Other ancillary data with the channel data is as in the VIRS level 1b product (TBC).

The first PGS tool must read the incoming level 1b product. This could be the basic read HDF tool. Assume the reformat function performs all reformatting required to produce VIRS.CID then the second PGS tool is the basic write non-HDF. The third tool is similar - basic read non-HDF tool i.e. in these 3 cases, the PGS tool performs the minimum access functions of read/write records; no additional functionality is required.

The prepare/reformat function itself must do the following:

regranulize from VIR level 1b product to 1 hour VIRS.CID - level 1b granule size unknown, maybe 24 hours

etc. (TBD)



A.09.4 Ingestion Route

VIRS 1b product being produced by TSDIS and archived at the GSFC DAAC. It is expected that level 0 deliveries are daily thus output of 1b is daily. Assuming transfer time to GSFC DAAC is negligible then VIRS 1b should be available in the GSFC DADS for access by LaRC DADS also within c. 24 hours of sensing. Direct transfer from TSDIS to LaRC could be conceived but is not in the current TRMM interface document. The DAAC to DAAC transfer seems most likely.

Note that any preparation could also be done at GSFC to avoid transferring unnecessary data to LaRC.

A.09.5 Verification

Minimal.

A.09.6. Group Responsible for Development

CERES team have identified the reformatting task and have indicated they will cover it. ECS will provide tools and verification

A.09.7 Temporal Availability and Source Security

Operational TRMM products will not be available until 6 months after launch. This leaves a serious hole in CERES processing for this period. Solutions are that

- VIRS product could be released early
- CERES processing is left incomplete for the same period (impact unknown)
- use backup source

A.09.8 Backup source

ISCCPs data are cited as the backup source. These data are also used as input to process 7. to fill missing TOAR. As backup to CID, there is a question over the spatial resolution of 35 km as compared to VIRS resolution; also, is ISCCP available in a timely fashion. The more promising backup might be the NOAA/POES HIRS and AVHRR cited by CERES as being used for pre-launch processing. **If used to support early TRMM CERES processing, this would involve the acquisition of these data in the 24 hour time scale; the volume could be significant.**

ISCCP data are archived at LaRC and should present no problem for access. The NOAA data route is TBD (possibly via GSFC DAAC).

A.09.9. Schedule for Source, Ingestion Route and Associated Developments

The reformat function identified by CERES team need to be defined, this is probably not a major task. The basic read/write PGS tools will be available from spring ‘94. The outstanding question is over the 6 month post-launch period, whether a backup source is used and if so what preparation steps would be necessary.

A.09.10 Testing

Data for testing will come from POES AVHRR/HIRS or ISCCP. Access to these data should cause little problem to the LaRC team; these data are well known. The original 1b are at GSFC and NOAA/NESDIS. ISCCP are at LaRC.

A.10 Surface Types : SURFMAP : Cloud WG

A.10.1 Introduction

SURFMAP is a major data set composed of a range of data sets. SPSO external reference N0079. The specific requirements are for: elevation, land type, snow type, sea-ice type, water type plus a range of specialized surface types. It is not yet clear what the precise nature of all of these requirements is, especially water type.

The specialized surface types are static and will be compiled by the CERES team (the 'STD' set). No further comment will be made on these types.

A.10.2 Source and Source Data set Attributes

Input	DCW_LND_SEA	WVS_LND_SEA	Terrain base	FNOC_Global_DEM	Ecosystem CD-ROM	TJTG01
Detailed Requ'ment	Land surface type	Land surface type	Surface Elevation	Surface Elevation	Vegetation	Vegetation
parm #	893	893	892	892	?	?
Parm/Product Name	Digital Chart of the World	World Vector Shorelines	DEM	DEM	Ecosystems	Vegetation index
Other name						
Instrument	n/a	n/a	n/a	n/a	n/a	AVHRR
Platform	n/a	n/a	n/a	n/a	n/a	POES
DAAC/ADC	ECS	ECS	ECS	ECS	ECS	NESDIS
from	Jan-1990	Jan-1990	Jan-1990	Jan-1990	Jan-1990	Jan-1990
to	Jan-2010	Jan-2010	Jan-2010	Jan-2010	Jan-2010	Jan-2010
GB/day	n/a	n/a	n/a	n/a	n/a	?
Units	n/a	n/a	?	?	?	NDVI
Accuracy (Abs:Rel)	1-3km	500m-kms	?	?	?	?
Temporal Res.	n/a	n/a	n/a	n/a	?	weekly

Horizontal Res:Cover	1:1000,000	1:250,000	?	10'	?	24km :global
Vertical Res:Cover	n/a	n/a	?	1000ft	?	n/a

Input	**AVHRR_WEEKLY_SNOW**	**TJZN01**	**SSMI_SNOW**	**AVHRR_MONTHLY_SNOW**
Detailed Requ'ment	Snow Type, Sfc	Snow Type, Sfc	Snow Type, Sfc	Snow Type, Sfc
parm #	894	894	894	894
Parm/Product Name	Snow cover analysis (digitized fields)	snow cover analysis (chart)	Snow ice cover (Navy alg.)	Snow cover monthly (mean, frequency, anomoly)
Other name	0	0		
Instrument	AVHRR, VISSR	AVHRR, VISS	SSM/I	AVHRR, VISSR
Platform	GOES/POES/METEO SAT/GMS	POES, GOES	DMSP	GOES/POES/METEO SAT/GMS
DAAC/ADC	NESDIS	NESDIS	NESDIS	NESDIS
from	Jan-1990	Jan-1990	Jan-1990	Jan-1990
to	Jan-2010	Jan-2010	Jan-2010	Jan-2010
GB/day	?	?	?	?
Units	?	n/a	?	?
Accuracy (Abs:Rel)	?	n/a	?	?
Temporal Res.	weekly	weekly	6 hours	monthly
Horizontal Res:Cover	n/a:N Hemis	4 km : N Hemis	25km:orbital swaths	n/a:N Hemis
Vertical Res:Cover	n/a	n/a	n/a	n/a

Input	MIM18	MIM22	MIM23	AVHRR_ICE
Detailed Requirement	Snow Type, Sfc	Sea-ice Type, Sfc	Sea-ice Type, Sfc	Ice edge
parm #	3713	3611	3609	896
Parm/Product Name	Snow Depth*	Sea Ice Concentration	Sea Ice Type	Mapped AVHRR (Ice) imagery
Other name	Snow Depth	Sea_Ice Conc	Sea_Ice Type	
Instrument	MIMR	MIMR	MIMR	AVHRR etc.
Platform	PM	PM	PM	various
DAAC/ADC	NSIDC	NSIDC	NSIDC	JIC
from	Dec-2000	Dec-2000	Dec-2000	Jan-1990
to	Jun-2006	Jun-2006	Jun-2006	Jan-2010
GB/day	0.005	0.009	0.009	?
Units	0	0	0	?
Accuracy (Abs:Rel)	0	7% ::	11% ::	?
Temporal Res.	0	0	0	weekly
Horizontal Res:Cover	23 km :: Land	12 km :: Ocean/Cryo	12 km :: Ocean/Cryo	?
Vertical Res:Cover	N/A :: Sfc	N/A :: Sfc	:: Sfc	?

The tables show potential sources of land/sea, DEM, vegetation and snow/ice cover.

The DCW product is being developed at ECS for use with a tool which provides land/sea information. Parallel work at LaRC is using WVS.

DEM requirements for CERES given in an EDC document (Topographic Data Requirements for EOS Global Change Research', by Gesch) are for 10 km horizontal and 50-100 m vertical resolution. Various products are currently being developed, several of which could satisfy this requirement. The only current global DEM is Terrainbase produced by NGDC. This is a derivative of the older ETOP05 which has a 5 arcminute horizontal resolution and an X m vertical resolution. The FNOC product is 10' and poorer vertical resolution but is being used for development work at LaRC.

For vegetation, the CERES team have cited 3 possible sources. The principal source is the NGDC Ecosystem database while the alternate and backup sources are NASA-GISS and NOAA weekly NDVI (source maybe NMC - TBC). A major question arises as to whether the requirement is for static (NGDC database) or dynamically changing data (weekly NDVI). The source in this case will have a very significant effect on aspects of auxiliary data handling.

For ice and snow, there are a range of NOAA products as well as the JIC sea ice product (output is hardcopy but ice edge is digitized for various areas including global weekly which is sent to NMC (TJZN01). MIMR should, in time, produce several parameters of potential.

Level of importance of all these data sets is TBD.

A.10.3 Interface to Processing

SURFMAP will input to CERES processes 4. Currently, CERES have defined a specification for SURFMAP which is a data file containing all of these data sets. Apart from land/sea and DEM, most of the various potential sources update dynamically. It is probably unwise to develop such a structure which would require reconstitution on a daily or weekly basis of data value not expected to change. Instead it is anticipated that a separate file for each source of data would be accessed through the PGS_Anc tools(s). The PGS tool should allow similar data sets (e.g. sea ice and snow) to be accessed through the same interface. Consequently, few interface calls would be necessary. Alternatively, and single SURFMAP file could be created from a pre-processing step using the separate inputs files. This pre-processing step, specific to CERES would have to be developed by CERES.

The preparation required for the land/sea, DEM and ecosystems (vegetation) data sets are a one-time effort before launch. It is unclear whether CERES requirement will be met by the DEM defined for general use by ECS or whether a particular format will be required; although ISCCP like equal area (10km) cells are cited. This is not the preferred format for a general ECS static data set.

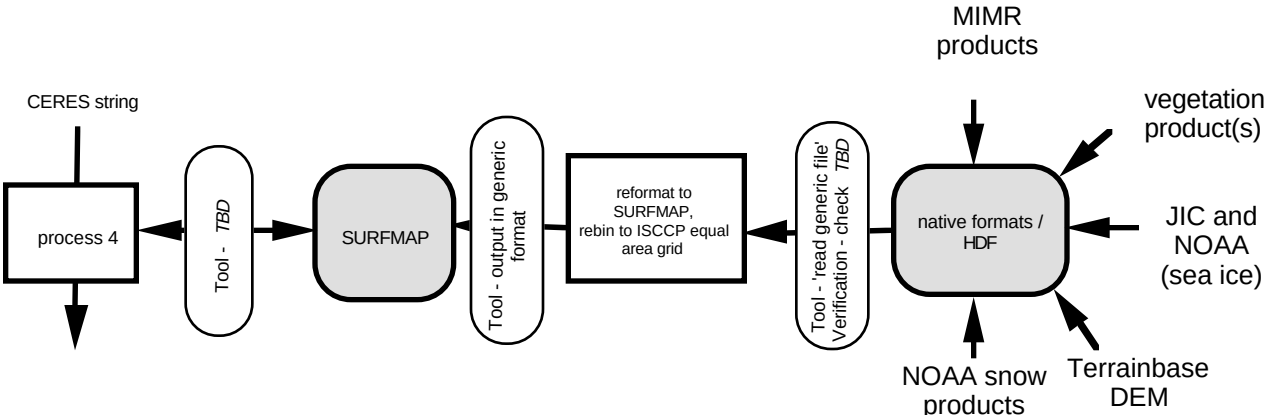
The requirements indicate 'water types' for which there is no given or obvious source.

The JIC product will have to be transformed into a raster format in the equal area grid required by SURFMAP. This preparation is somewhat different to that for other data sets since the sea ice edge is likely to be in vector format.

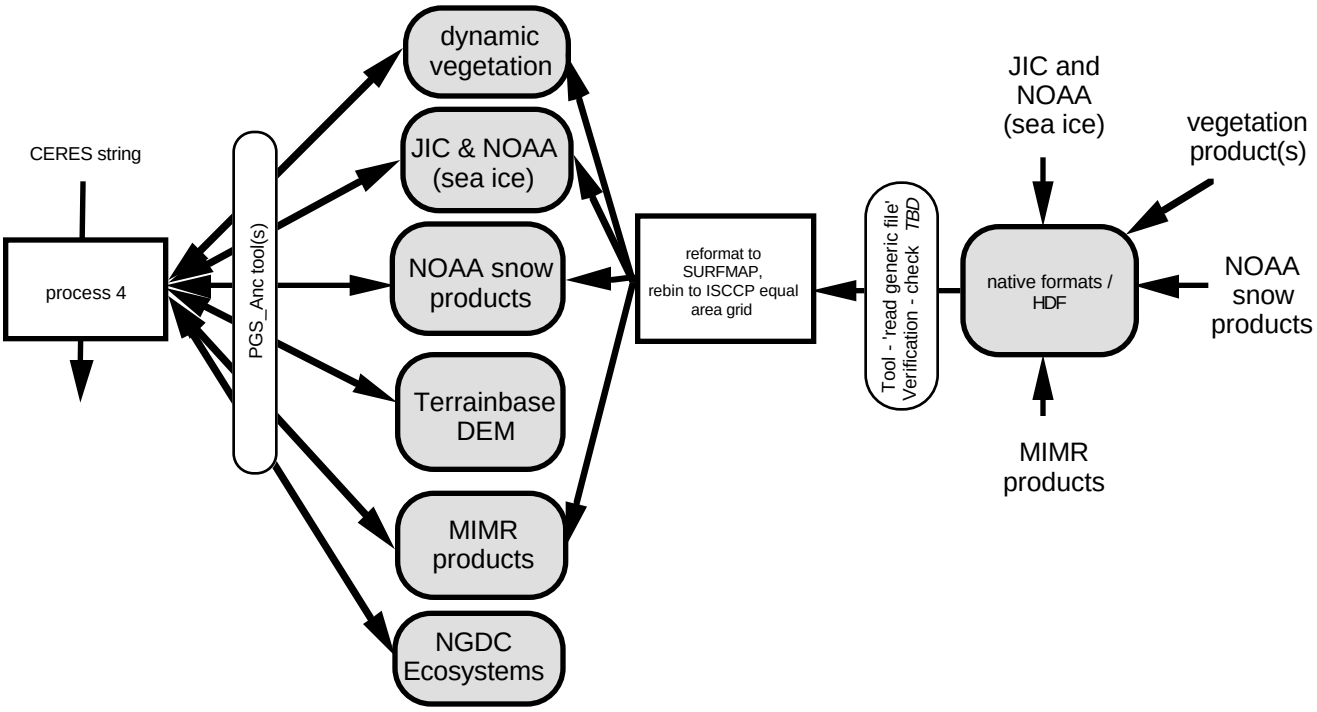
A.10.4 Ingestion Route

JIC digital products could be available in digitized format - limited areas now available on OMNET bulletin board. The update rate for several of the products is weekly, some decisions on which product to use for each day of processing is required. The NOAA products should be available via the SAA.

PREPARATION TO A SINGLE SURFMAP FILE



PREPARATION OF SEPARATE DATA SETS



A.12.5 Verification

tbd

A.10.6. Group Responsible for Development

With respect to the DCW and WVS work, agreement and coordination of resources is necessary. ECS will developed tools to access at least one general purpose DEM (i.e. Terrainbase) as well as supplying Terrainbase, the FNOC data set and the ecosystems CD-ROM. This tool will include search functionality based on lat/long calling parameters. **The other main sources will also be developed by ECS assuming they are either static and readily available and are requested by more than one instrument team.** The pre-processor is specific to CERES and should be developed by the CERES DPT.

Agreement and coordination of resources is necessary.

A.10.7 Temporal Availability and Source Security

The dynamic data sets from NOAA are assumed to be available on an on-going basis. MIMR will not be available until 2000 and may therefore not get used.

As an operational and military center, JIC can be expected to be continuous and reliable in product output.

A.10.8 Backup source

Multiple sources undecided on.

A.10.9. Schedule for Source, Ingestion Route and Associated Developments

The develop of the DCW and Terrainbase DEM and tools will take place during the summer of 1994.

A.10.10. Testing

The static data sets should be available through the PGS_Anc tool by fall '94. Other data sets are TBD.

A.11 ISCCP Radiance : GEO : TISA WG

A.11.1 Introduction

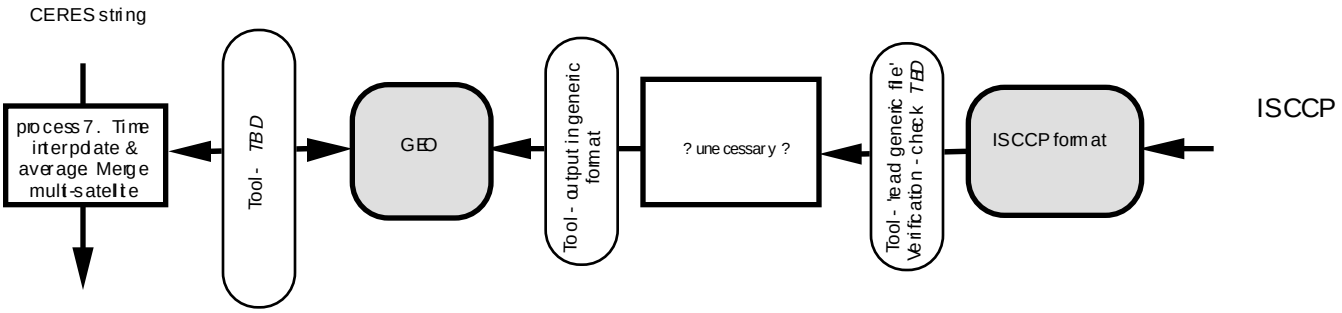
Input into processes 10 and 7. SPSO external reference N0076.

A.11.2 Source Data set Attributes

Calibrated ISCCP B3 radiances

A.11.3 Interface to Processing

Little or no preparation is required. Since these data are already in use at LaRC, then the interface functionality will be available.



A.11.4 Ingestion Route

Current ingestion to LaRC is assumed to continue

A.11.5 Verification

tbd

A.11.6. Group Responsible for Development

CERES team currently use this data set, assume all development other than simple i/o tools from the ECS.

A.11.7 Temporal Availability and Source Security

Unknown

A.11.8 Backup source

None ?

A.11.9. Schedule for Source, Ingestion Route and Associated Developments

CERES team internal

A.11.10 Testing

Assume CERES internal.

A.12 Conclusions

A.12.1 Critical Dependencies and Sources

CERES product generation is critically dependent on a wide range of ancillary data products including NMC analysis fields, a number of NESDIS operational products, MODIS and VIRS. The first two sources, while critical, can be considered secure given their long standing and possibilities for the introduction of backups. Almost all of the specific data products are required by other instruments and will therefore be supplied centrally by ECS (see later source specific chapters). However, the latter two sources (MODIS and VIRS) are both unproven and have no backups - especially their supply of data for cloud masking. The establishment of a supply route is not at issue, since both products are archived at EOSDIS DAACs.

There appears to be a significant problem with the provision of MWP and MWH from coincident sources for EOS-AM. The backup sources discussed (especially SSM/I) must become the primary source in these cases.

A.12.2 Implications for PGS Toolkit Ancillary Data Handling Tool

The various requirements are dominated by the atmospheric data structure (ASTR) and the so-called SURFMAP. In both cases, the ancillary data are required to be in equal area 1.25 degree grids. Since this is a CERES specific requirement, then the CERES DPT should develop a tool - perhaps a generic rebinning tool, which could well already exist in part at LaRC.

The PGS toolkit ancillary tool gives general access to many data sets by lat/long or in certain cases by direct reference to the data structure of the data set. The tool should be interposed to form an interface between external sources and SURFMAP and ASTR, allowing the preparation functions format free access to the sources. This would satisfy the ECS requirement to provide a tool to insulate science algorithms from the external environment. The tool could also be interposed between ATSR and SURFMAP and the algorithmic processes which use them. This would only be necessary if (say) ATSR production was separated from the rest of the system on another machine.

A.12.3 Implications for PGS Pre-processing and ECS Interfaces

The use of NMC and NESDIS products is widespread and will be commented further in chapter 10.

Specific to CERES, it is obviously critical that the subsetting of the MODIS product and generation of additional data to produce MODIS.CID occurs at GSFC. For VIRS.CID, should the AVHRR 1b backup be used then this would involve the acquisition of these data in the 24 hour time scale which will create a much greater overhead than for other NESDIS products.

For aerosol data, should the strength of the requirement for stratospheric data be prove great then non-US sources must be used. The ingestion mechanism and interface would become a major issue.

A.12.4 Outstanding Issues

There are two outstanding issues:

- NASA guidance is required as to whether to develop source such as ECMWF (GAP backup), ADEOS for TOMS (OPD) and possibly ILAS and any of the European sources.
- ECS must affirm that all sources that are readily available and are requested by more than one instrument team will be developed by ECS . This will prevent repetition of effort, especially for static data sets.

Appendix B LIS

B.01 Introduction

Standard processing of TRMM-platform LIS data is not greatly dependent on ancillary data inputs. Ancillary data will be necessary in the geolocation of LIS Level 1A data and in matching of Level 2A lightning events to TRMM-platform precipitation observations. LIS will also routinely require a number of correlative inputs, such as satellite imagery, sounding data and ground lightning and radar data, for the purposes of validation and product improvement. However, it should be considered that reclassifying these various correlative inputs as ancillary inputs to standard processing would dramatically increase LIS' data dependencies. Close evaluation of the potential processing impacts is needed.

Figure B-1 displays the LIS processing steps at which external data inputs will be required. This high level diagram of LIS processing was constructed on the basis of the SPSO tables and conversations with LIS team members.

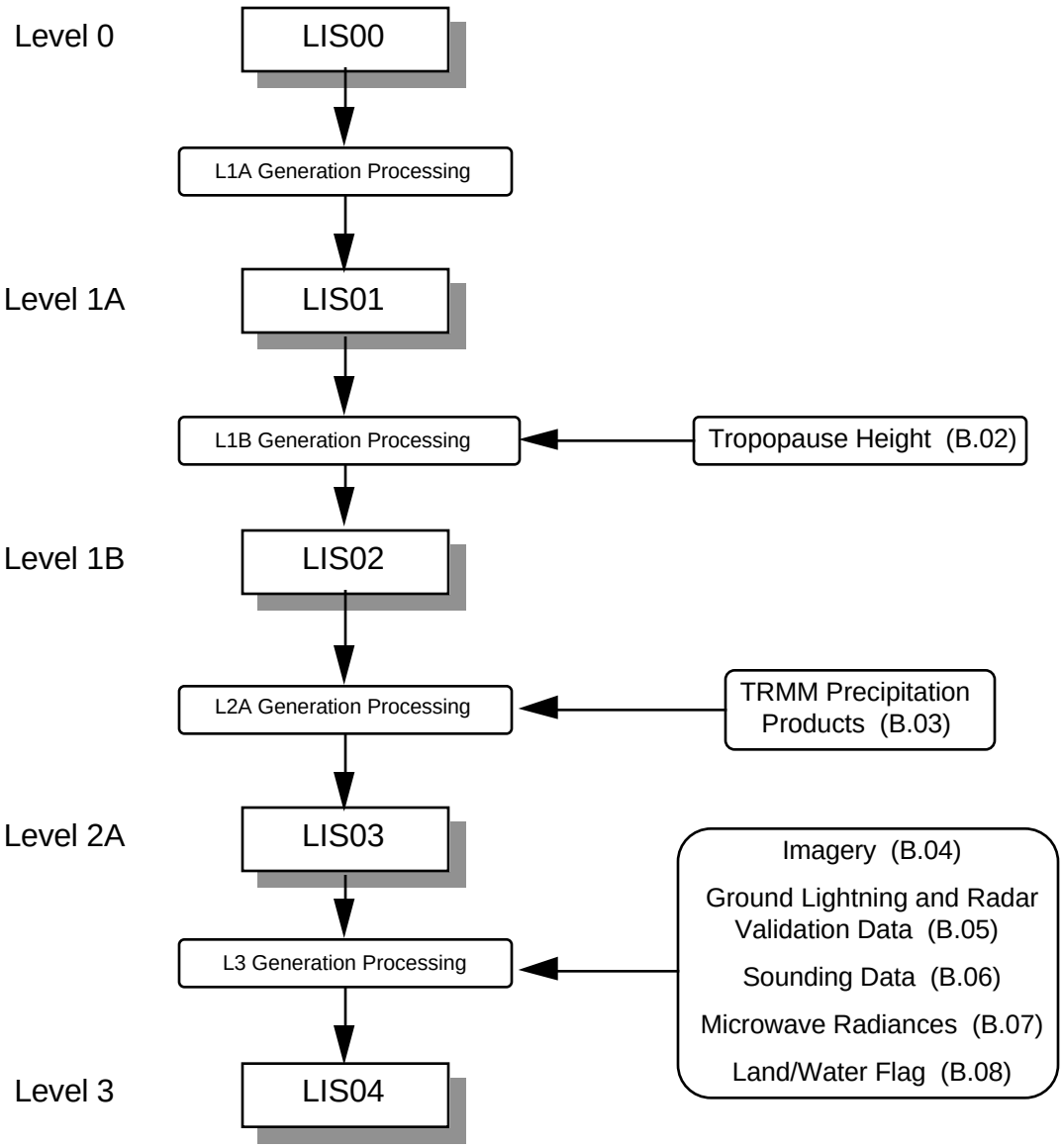


FIGURE B-1 External Inputs to LIS Processing

B.02 Tropopause Height

B.02.1 Introduction

Tropopause height fields will be required as Ancillary data in the LIS processing which generates the LIS Level 1B product LIS02. A gridded tropopause height analysis field will be used as a geolocation reference surface during LIS L1B generation, where the working assumption is that the lightning will be occurring at the top of storms. Tropopause height values will be used to geolocate the lightning events found in the Level 0 LIS data. This parameter does not currently appear as an SPSO external option. It is being added as a result of conversations with the LIS team and has been provisionally assigned as external option N0100.

B.02.2 Source and Source Data set Attributes

Input	ECMWF_HEIGHT
Parm #	---
Parm/ Product Name	Analyzed Tropopause Height Model
Instrument	N/A
Platform	N/A
DAAC/ADC	ECMWF
from	?
to	?
GB/day	?
Units	?
Accuracy (Abs:Rel)	?
Temporal Res.	?
Horizontal Res:Cover	?
Vertical Res:Cover	?

ECMWF analysis is currently the only source that has been identified for this LIS geolocation reference surface. The LIS team has indicated that an alternative may be to use a TBD standard elliptical atmosphere model to which the height of the tropopause (ranging from ~10-15 km) has been added.

B.02.3 Interface to Processing

Tropopause height data will be required as input to the geolocation algorithm during the generation of LIS Level 1B products. LIS requirements for any necessary preparation of the tropopause height analysis are TBD. It is anticipated that the PGS Toolkit routine PGS_AA_GEO will meet LIS' needs for access to this tropopause height data.

B.02.4 Ingestion Route

It is not currently known how ECS will ingest ECMWF derived analyses.

B.02.5 Verification

TBD

B.02.6. Group Responsible for Development

Any preparation or preprocessing function for this data would likely be specific to LIS and would be developed by the LIS data processing team.

B.02.7 Temporal Availability and Source Security

The LIS team had indicated that initially an annual average tropopause height would be sufficient, but that more frequent analysis updates to this may be desirable as TBD more dynamic sources are identified.

B.02.8 Backup source

Although no backup source has been identified, products developed by NMC or by the NASA/GSFC Data Assimilation Office (DAO) may serve as backups.

B.02.9. Schedule for Source, Ingestion Route and Associated Developments

The tools for basic non-HDF read/write should be available by Spring 1994. Any unique preparation procedures for ECMWF data will have to wait on detailed information on product formats for this parameter.

B.02.10 Testing

TBD

B.03 TRMM Precipitation Products

B.03.1 Introduction

Precipitation products from TRMM-platform instruments will be required as Ancillary data in the LIS processing which generates the LIS Level 2A product LIS03. The TRMM precipitation products will supply a means for correlating lightning strike events observed by LIS with precipitation features observed by other instruments on the TRMM platform (i.e. PR, TMI & VIRS). This parameter does not currently appear as an SPSO external option. It is being added as a result of conversations with the LIS team and has been provisionally assigned as external option N0110.

B.03.2 Source and Source Data set Attributes

Input	2A-12	2A-23	2A-24	2A-25	2B-31	SSMI_ PRECIP	SSMI_ RAIN
Parm #	---	---	---	---	---	---	---
Parm/ Product Name	Surface rainfall rate + hydrometeor and latent heating profiles at ~15 levels	Rain/no-rain, rain type, etc.	Standard Z-R rainfall rates	PR Profile; estimate of rainfall & water content	TRMM combined surface rainfall rate & profiles	Total Precipitable Water (Navy algorithm)	Instantan-eous Rainfall (Navy algorithm)
Instrument	TMI	PR	PR	PR	TMI & VIRS	SSM/I	SSM/I
Platform	TRMM	TRMM	TRMM	TRMM	TRMM	DMSP	DMSP
DAAC/ADC	TSDIS	TSDIS	TSDIS	TSDIS	TSDIS	NESDIS	NESDIS
from	Aug-1997	Aug-1997	Aug-1997	Aug-1997	Aug-1997	Mar-1991	Mar-1991
to	Jul-2000	Jul-2000	Jul-2000	Jul-2000	Jul 2000	?	?
GB/day	6.205	0.154	1.235	5.298	5.957	?	?
Units	?	?	?	?	?	?	?
Accuracy (Abs:Rel)	?	?	?	?	?	?	?
Temporal Res.	?	?	?	?	?	6 hours	6 hours
Horizontal Res:Cover	?	?	?	?	?	25 km :: orbital swaths	25 km :: orbital swaths
Vertical Res:Cover	?	?	?	?	?	N/A	N/A

The source for this data will be the TRMM TMI, PR and VIRS precipitation products as transmitted once daily to ECS by TSDIS. It is not clear which of the potential TRMM precipitation products will best suited to LIS ancillary requirement. All of the listed Level 2

TRMM precipitation products are swath-based. The combined TMI & VIRS product 2B-31 only covers the 677 km TMI swath width, not the entire 720 km VIRS swath width.

B.03.3 Interface to Processing

TRMM-platform precipitation measurements will be necessary input to the generation of LIS 2A products. All Level 2 TRMM precipitation products delivered by TSDIS to ECS are expected to be in HDF format. Suitable PGS Toolkit PGS_IO_HDF routines should provide the ancillary tool access to the data. LIS requirements for any necessary preprocessing, subsetting or regridding are TBD.

B.03.4 Ingestion Route

TRMM PR, TMI and VIRS products are being produced by TSDIS at GSFC. VIRS Level 1A - 3B products will be distributed by TSDIS once daily to ECS at the GSFC DAAC. PR and TMI Level 1A - 3B products will be distributed by TSDIS once daily to ECS at the MSFC DAAC, where the data will be made available to the LIS science processing string. It is not known whether the combined TMI & VIRS product 2B-31 will be distributed by TSDIS to the GSFC or the MSFC DAAC.

B.03.5 Verification

TBD

B.03.6. Group Responsible for Development

TBD

B.03.7 Temporal Availability and Source Security

TSDIS may not make operational TRMM products available for 6 months after the TRMM launch. This leaves a gap in coverage for this ancillary input to LIS processing. This is not a secure ancillary input, because unless the TMI, PR and VIRS products are released early, an as yet unidentified backup source will be required.

B.03.8 Backup source

SSM/I precipitation products from NOAA/NESDIS could conceivably be used as a backup source; two potential SSM/I products have been listed in section B.03.2. However, replacing the coincident TRMM-platform precipitation measurements with SSM/I products may not be suitable for LIS' processing needs.

B.03.9. Schedule for Source, Ingestion Route and Associated Developments

The tools for basic HDF read/write should be available by Fall '94.

B.03.10 Testing

TBD

B.04 Imagery

B.04.1 Introduction

Various satellite imagery will be required as correlative data for use in the LIS processing which generates the LIS Level 3 product LIS04. The satellite imagery products will supply a means for correlating lightning strike events to precipitation and storm features observed by other satellite instruments. This parameter does not currently appear as an SPSO external option. It is being added as a result of conversations with the LIS team and has been provisionally assigned as external option N0112.

B.04.2 Source and Source Data set Attributes

Input	GOES_ VISSR_ L1B	GOES_ VAS_L1B	GMS_ VISSR	MSAT_ LL_WND	MSAT_ CLDMOT_ WND	MSAT_ CLDMOT_ AUTO	MSAT_ WVMOT_ AUTO
Parm #	---	---	---	---	---	---	---
Parm/ Product Name	Level 1B Radiances/Imagery	Level 1B Radiances/Imagery	Imagery	Low-Level Winds	Cloud motion winds	Cloud Motion Autowinds	Water Vapor Motion Autowinds
Instrument	VISSR	VAS	VISSR	Imager	Imager	Imager	Imager
Platform	GOES	GOES	GMS	METEOSAT	METEOSAT	METEOSAT	METEOSAT
DAAC/ADC	NESDIS	NESDIS	Japan	?	?	?	?
from	Dec-1985	Dec-1985	?	Jan-1990	Jan-1990	Jan-1990	Jan-1990
to	Dec-2005	Dec-2005	?	Jan-2010	Jan-2010	Jan-2010	Jan-2010
GB/day	1.1454	1.3158	?	?	?	?	?
Units	?	?	?	?	?	?	?
Accuracy (Abs:Rel)	?	?	?	(+/-) 2-6 m/s	700-1000 mb :: (+/-) 5-8 m/s	700-1000 mb :: (+/-) 5-8 m/s	400-1000 mb :: (+/-) 6-9 m/s
Temporal Res.	?	?	?	6 hours	6 hours	6 hours	6 hours
Horizontal Res:Cover	?	?	?	5 km :: Hemispheric	5 km :: Hemispheric	5 km :: Hemispheric	5 km :: Hemispheric
Vertical Res:Cover	N/A	N/A	N/A	N/A	~25 mb	~25 mb	~50 mb

The sources for this imagery data will be GOES, Meteosat and GMS image products.

B.04.3 Interface to Processing

This satellite imagery will be correlative input as LIS Level 3 products are evaluated and validated. After a period of LIS evaluation, these Correlative imagery products may be required as ancillary inputs to the LIS04 generation process; however, any preprocessing functions are TBD. The LIS team may initially use McIDAS software to view the various imagery as the LIS04 product is generated and evaluated. It is believed that the PGS Toolkit routine PGS_AA_2DRead might meet LIS' needs for access to this imagery data.

B.04.4 Ingestion Route

GOES Level 1B VISSR and VAS imagery products are being produced and distributed by NOAA/NESDIS. The ingest routes for both the GMS and Meteosat imagery are not known at this time.

B.04.5 Verification

TBD

B.04.6. Group Responsible for Development

TBD

B.04.7 Temporal Availability and Source Security

GOES products are assumed to be available electronically from NESDIS in near real time. It is expected, but not yet been confirmed, that ingest of GMS and Meteosat data can also be made in a timely fashion.

B.04.8 Backup source

It is not clear which of these image products will be designated as backup sources.

B.04.9. Schedule for Source, Ingestion Route and Associated Developments

The tools for basic non-HDF read/write should be available by Spring '94.

B.04.10 Testing

TBD

B.05 Ground Lightning and Radar Validation Data

B.05.1 Introduction

Various ground radar and lightning network observations will routinely be required as correlative data for use in the generation of the LIS Level 3 product LIS04. These correlative data sets are needed to relate the LIS lightning strike data to meteorological systems for the purpose of off-line LIS quality control, research validation and product improvement. This parameter does not currently appear as an SPSO external option. It is being added as a result of conversations with the LIS team and has been provisionally assigned as external options N0113 (lightning) and N0114 (radar).

B.05.2 Source and Source Data set Attributes

Input	LIGHTNING_OBS	NEXRAD	1B-51	1C-51	2A-52i	2A-53	2A-55	2A-56
Parm #	---	---	---	---	---	---	---	---
Parm/ Product Name	Ground lightning strike data	NEXRAD radar volume scans	TRMM Ground Validation radar; Level 1B	TRMM Ground Valid. radar; Level 1C	TRMM Ground Valid. radar; rain existence	TRMM Ground Valid. radar; single site rain-rate map	TRMM Ground Valid.; rain gauge	TRMM Ground Valid.; disdrometer
Instrument	various	WSR88D	Radar	Radar	Radar	Radar	Rain gauge	Disdrometer
Platform	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
DAAC/ADC	?	?	TSDIS	TSDIS	TSDIS	TSDIS	TSDIS	TSDIS
from	?	?	?	?	?	?	?	?
to	?	?	?	?	?	?	?	?
GB/day	0.002	1.6488	1.717	3.799	0.000004	0.631	0.02	0.02
Units	?	?	dBZ	?	?	?	?	?
Accuracy (Abs:Rel)	?	?	?	?	?	?	?	?
Temporal Res.	?	?	?	?	?	?	?	?
Horizontal Res:Cover	?	?	?	?	?	?	?	?
Vertical Res:Cover	?	?	?	?	?	?	?	?

The source of the lightning observations will be data obtained from the National Lightning Network. Ground radar data will be available from NEXRAD observations and from data

obtained from TRMM Ground Validation radar sites. TRMM Ground Validation radar and rain gauge data will be made available to ECS by TSDIS, however it is not clear which of the TRMM Ground Validation products listed above will be required by LIS.

B.05.3 Interface to Processing

Ground lightning and radar will be correlative input as LIS Level 3 products are evaluated and validated. After a period of LIS evaluation, these correlative products may be required as ancillary inputs to the LIS04 generation process.

B.05.4 Ingestion Route

Lightning observations will reportedly be available electronically from the National Lightning Network, but more investigation is needed for this ingest source. LIS team members have stated that additional arrangements are being made to organize a database of lightning observations. NEXRAD data will be ingested by ECS electronically from either NOAA/NESDIS or NGDC. TRMM Ground Validation radar data will be collected and processed by TSDIS. ECS will receive a daily transmission of Level 2 and 3 TRMM Ground Validation products, likely to the GSFC DAAC. DAAC to DAAC transfer would then make the TRMM radar data available to LIS science processing strings at the MSFC DAAC.

B.05.5 Verification

TBD

B.05.6. Group Responsible for Development

Any preparation or preprocessing function for this data would likely be specific to LIS and would be developed by the LIS data processing team.

B.05.7 Temporal Availability and Source Security

TRMM Ground Validation products are assumed to be transmitted by TSDIS to ECS on a daily basis.

B.05.8 Backup source

No other sources have been identified at this time.

B.05.9. Schedule for Source, Ingestion Route and Associated Developments

The tools for basic non-HDF read/write should be available by Spring '94.

B.05.10 Testing

TBD

B.06 Sounding Data

B.06.1 Introduction

Various satellite sounding data will routinely be required as correlative data during generation of the LIS Level 3 product LIS04. Temperature and water vapor sounding data will be used to help match lightning strike events to meteorological data for the purpose of off-line LIS quality control, research validation and product improvement. This parameter does not currently appear as an SPSO external option. It is being added as a result of conversations with the LIS team and has been provisionally assigned as external option N0115.

B.06.2 Source and Source Data set Attributes

Input	**TCDG01**	**SSMT2_SND**
Parm #	---	---
Parm/ Product Name	Layer-mean virtual temperature	Sounding data; water vapor profiles
Instrument	SSM/T	SSM/T-2
Platform	DMSP	DMSP
DAAC/ADC	NESDIS	NESDIS
from	Jan-1990	Jan-1994
to	Jan-2010	Jan-2010
GB/day	?	?
Units	K	?
Accuracy (Abs:Rel)	2.25 - 3.5 K	?
Temporal Res.	110 mins	?
Horizontal Res:Cover	175 km :: orbital swath	50 km at nadir. 75 km at view angle of 40.5 degrees
Vertical Res:Cover	11 layers	?

The source for this data will be SSM/T and SSM/T-2 soundings from the DMSP satellites.

B.06.3 Interface to Processing

These DMSP sounding products will be necessary correlative inputs to the evaluation and validation of LIS Level 3 products. After a period of LIS evaluation, these correlative sounding products may be required as Ancillary inputs to the LIS04 generation process; however any preprocessing functions are TBD. It is anticipated that the PGS Toolkit routine PGS_AA_3DGeo/Read will meet LIS' needs for access to this DMSP data.

B.06.4 Ingestion Route

SSM/T virtual temperature and SSM/T-2 water vapor sounding products are being produced operationally by NOAA/NESDIS and should be available electronically through the NESDIS Satellite Active Archive (SAA) system currently under development.

B.06.5 Verification

TBD

B.06.6. Group Responsible for Development

TBD

B.06.7 Temporal Availability and Source Security

Operational DMSP SSM/T and SSM/T-2 sounding products are assumed to be available orbitally and in near real time from NESDIS.

B.06.8 Backup source

No other sources have been identified at this time. The possibility exists that a suitable product may developed by DAO and distributed by ECS.

B.06.9. Schedule for Source, Ingestion Route and Associated Developments

The tools for basic non-HDF read/write should be available by Spring '94.

B.06.10 Testing

TBD

B.07 Microwave Radiances

B.07.1 Introduction

SSM/I Level 1B radiances will routinely be required as correlative data for use in the LIS processing which generates the LIS Level 3 product LIS04. SSM/I L1B brightness temperatures will be used to match lightning strike events to SSM/I-observed features for the purpose of off-line LIS quality control, research validation and product improvement. This parameter does not currently appear as an SPSO external option. It is being added as a result of conversations with the LIS team and has been provisionally assigned as external option N0116.

B.07.2 Source and Source Data set Attributes

Input	**SSMI_L1B**
Parm #	---
Parm/ Product Name	Level 1B radiances, Brightness temperatures
Instrument	SSM/I
Platform	DMSP
DAAC/ADC	NESDIS
from	Jan-1990
to	Jan-2010
GB/day	?
Units	K
Accuracy (Abs:Rel)	?
Temporal Res.	orbital
Horizontal Res:Cover	12.5 - 25 km :: orbital swaths
Vertical Res:Cover	N/A

The source for this data will be orbital SSM/I Level 1B brightness temperature data from the DMSP satellites.

B.07.3 Interface to Processing

These DMSP microwave radiances will be necessary inputs during the evaluation and validation of LIS Level 3 products. After a period of LIS evaluation, SSM/I Level 1B data may be required as ancillary input for the generation of LIS04; however, any preprocessing functions are TBD.

P{GHS_AA_2DRead/Geo may meet this requirement, although there is concern over the geolocation and orientation of access routines.

B.07.4 Ingestion Route

Operational SSM/I Level 1B products are expected to be ingested by ECS electronically via the NESDIS SAA.

B.07.5 Verification

TBD

B.07.6. Group Responsible for Development

Any preparation or preprocessing function for this data would likely be specific to LIS and as such would be developed by the LIS data processing team.

B.07.7 Temporal Availability and Source Security

SSM/I Level 1B data sets are assumed to be available orbitally and in near real time from NESDIS.

B.07.8 Backup source

No other sources have been identified at this time.

B.07.9. Schedule for Source, Ingestion Route and Associated Developments

The tools for basic non-HDF read/write should be available by Spring '94.

B.07.10 Testing

TBD

B.08 Land/Water Flag

B.08.1 Introduction

Land/Water flags will routinely be required as Correlative data in the LIS processing which generates the LIS Level 3 product LIS04. These Land/Water flags are necessary for the effective use of other external data sets, such as ground lightning and radar data (B.05) and DMSP products (B.06, B.07). This data will be used for the purpose of off-line LIS quality control, research validation and product improvement. This parameter does not currently appear as an SPSO external option. It is being added as a result of conversations with the LIS team and has been provisionally assigned as external option N0111.

B.08.2 Source and Source Data set Attributes

Input	**DCW_LND_SEA**
Parm #	---
Parm/ Product Name	Land/Sea Flag from Digital Chart of the World
Instrument	N/A
Platform	N/A
DAAC/ADC	ECS
from	?
to	?
GB/day	N/A
Units	?
Accuracy (Abs:Rel)	1 - 3 km
Temporal Res.	N/A
Horizontal Res:Cover	1 : 1,000,000
Vertical Res:Cover	N/A

The source for this data is expected to be a ECS maintained data set derived from the Digital Chart of the World data.

B.08.3 Interface to Processing

As an input to LIS04 generation processing, the preparation required for this Land/Water data set is expected to be a one time effort before launch. It is anticipated that the PGS Toolkit routine PGS_AA_DCW will meet LIS' access needs for this data.

B.08.4 Ingestion Route

DCW surface classification products are expected to be provided by ECS.

B.08.5. Group Responsible for Development

If there are LIS-specific preprocessor requirements, they should be developed by the LIS data processing team.

B.08.6 Testing

ECS development of the DCW, as well as the tools to access it, will take place during the summer of 1994. The static land classification data set and the tool(s) to access it should be available by Fall 1994.

B.09 Conclusions

Although LIS is not heavily dependent on ancillary data, a number of inputs have been identified here. LIS processing will require several inputs which are not currently reflected in the SPSO lists. In addition, the correlative data inputs discussed here have a great potential of becoming required ancillary inputs to LIS standard processing.

A major concern is the lack of source security for the TRMM-platform precipitation products required as input for the generation of Level 2A products. Any delays in the transfer of these precipitation products to ECS from TSDIS may make this ancillary input unavailable to LIS processing strings.

More information and discussion is needed with the LIS team regarding their format requirements for input data to their processing algorithms, as well as what PGS tool interfaces are foreseen.

Appendix C MODIS

Introduction

Ancillary Data Required for MODIS Level 2 Product Generation

In this appendix, the predominant ancillary data sets described are for the processing of MODIS Level 1B data into Level 2 Standard Products. The MODIS Level 2 Products are classified into three main discipline areas, ocean, land and atmospheric products. Even so, the ancillary data requirements are similar for all three product groups. The use of these ancillary data during processing varies for each group.

For MODIS Level 1A, the ancillary data requirements are predominantly emphemeris from the AM Platform, the MODIS engineering data and static data sets (e.g., digital elevation models) from various sources. Information about the static data sets are described in the latter sections of this appendix. For Level 1B, the ancillary data requirements are still being defined because of the redefining of the MODIS Level 1B Algorithm. The changes in the Level 1B algorithm includes the separation of the MODIS Cloud Mask from the Level 1B Processing. The ancillary data sets needed for the Cloud Mask are similar to the requirements for the Level 2 Products and probably can be met by identifying the requirements for the Level 2 Processing.

C.01 Gridded Analysis Product (GAP)

C.01.1 Introduction

Gridded Analysis Data such as NOAA National Meteorological Center (NMC) are required by several MODIS Level 2 Products (e.g., MOD04, MOD05, MOD18) as a primary input into the atmospheric correction procedures to develop Level 2 Products. The Data Assimilation Office (DAO) Global EOS (GEOS) Product and the ECMWF Model Data are potential backup sources for these atmospheric parameters. The SPSO external option is N0011.

The GAP parameters needed are the following:

1. surface pressure;
2. temperature and moisture profiles, (including surface levels);
3. relative humidity;
4. surface winds over the ocean; and
5. air mass type.

C.01.2 Source and Source Data set Attributes

NMC characteristics need further defining as far as gridding and actual formatting information.

C.01.3 Interface to Processing

The GAP data will be used in the Level 2 processing step to remove the amount of measured MODIS Level 1B radiances due to atmosphere attenuation. Prototype software of how these data are used in developing Level 2 MODIS Products should be available by the latter part of 1994 from several of the MODIS Ocean Team (MOT) members. These same MOT members are also part of the SEAWiFS Science Team and are developing software to generate Level 2 and 3 ocean color products (OCPs) from SEAWiFS Data. The SEAWiFS Data Processing System is currently ingest daily NMC data routinely using existing communication lines (i.e., Internet) between NOAA and GSFC .

NMC data are available in 12 hour intervals. The MOT would like to use the most recent NMC Model Data with respect to the MODIS daily data collection and process schedule, but have the concern that the preliminary Quality Checking (Q/C) of the model data be done. The MOT has heritage software to implement the pre-processing (i.e., ingestion, regridding and/or interpolation) of the analysis data to use in their OCP processing.

The MODIS Land Discipline Group (MODLAND Group) and the MODIS Atmospheric Group will also need these data, but have different processing techniques (and software) to correct Level 1B Radiances for Level 2 Products. The recent Algorithm Theoretical Basis Document (ATBD) Review may result in the three discipline groups combining their atmospheric correction techniques based on the Review Panel's recommendations to the MODIS Science Team (ST). At the moment, it appears the PGS Toolkit will need to support members of the MODIS ST with similar processing tools (e.g.., regridding and interpolating tools. also look up table access).

C.01.4 Ingestion Route

The ingestion route for NMC data is currently under study with the starting assumption that it will probably be centralized for all DAACs. Some sorting of products at this point will probably take place such that only those products required at each DAAC are transferred (TBD). Understanding how current processing systems at the GSFC DAAC (i.e., SEAWiFS and DAO) ingest these data may facilitate the development of procedures to use for ECS.

C.01.5 Verification

The MOT have developed techniques to do limited quality checks on analysis data used in processing remotely sensed data from sensors such as CZCS. Their software also has the necessary routines to use the previous NMC data (if archived at the DAAC) if the current model data is found to be erroneous.

More information is being sought and should be provided to the ECS PGS Group to help them understand how quality assurance of ancillary data is implemented. Other MODIS ST members may also have methods developed to do initial Q/C of NOAA/NMC data based on their use of the data in past and current research efforts.

C.01.6 Group Responsible for Development

All three discipline groups of the MODIS ST have the necessary routines to manipulate and use and use GAP data in developing their Level 2 MODIS Products. Whether the whole MODIS ST will converge on using the same processing techniques is TBD. Certain MODIS ST group such as the MOT are currently planning on using only the Open/Close PGS Toolkit Tool as far as Toolkit calls. The MOT has a suite of heritage software to handle NMC data in their processing. The plans of the other two discipline groups needs further clarification.

C.01.7 Temporal Availability and Source Security

NMC data is routinely produced because of its importance to global weather forecasting efforts. Hence, these data sets should be readily available for standard processing. If the MODIS ST determines, that the DAO GEOS Product is of superior quality after this product is being produced operationally, they may use the GEOS Product (versus NMC Analysis Data) in processing their Level 1B radiance data into Level 2 Products.

C.01.8 Backup source

One potential backup source is ECMWF. The products are similar (more information needed), but there is a cost implication of ingesting these data. ESDIS Project guidance is needed this if backup source is required.

The EOS GEOS Assimilation Product may become the principle GAP source once that product becomes operational. The acceptance of this product by the MODIS ST is TBD. If the early GEOS model can be produced operationally at the V0 GSFC DAAC, its use in generating SEAWiFS Products could provide value information on the GEOS models being developed for the EOS AM-1 era.

Fleet Numerical Operations Center (FNOC) also produce an analysis product which is archived at NCDC. Availability of this product within 24 hours needs further clarification. These data have been used by the MOT to date. Whether these data satisfy the other discipline groups is TBD.

NSCAT and NSCAT follow-on flights (on the ADEOS platforms) should provide global wind fields over the oceans for the Ocean Water Leaving Radiance Work. The MOT member generating SST from the Thermal Infrared (ThIR) Channels of MODIS has requested these data be obtained for his processing work.

Instruments flying on PM-1, AIRS/AMSU, are also capable of producing atmospheric temperature and humidity profiles and surface pressure data.

The Table found in Section 2.07 of Appendix 2 of this Discussion Paper provides more information about each of the potential backup sources listed above and other potential backup sources.

C.01.9 Schedule for Source, Ingestion Route and Associated Developments

The preprocessing of the gridded analysis data could be a significant development, especially if common development of science processing software (SPS) is involved covering several instruments. An early decision on the ingestion route for the Toolkit efforts should be made.

C.01.10 Testing

While NCDC archives observation data, it appears that the analysis and forecast grids are not archived (or only to a very limited degree). To obtain test data, some routine production would have to be captured. The DAO work currently captures 00z analysis and 00z and 12z forecast.

C.02 Total Column Ozone

C.02.1. Introduction

The total column ozone data is used in Level 2 processing to perform atmospheric corrections to the MODIS Level 1B Data to generate water and land leaving radiances. The SPSO external option is N0015.

C.02.2 Source and Source Data Set(s) Attributes

Table C.02.2-1 list several sources of ozone product data in the EOS-AM1 time frame. To date, processed data from the Total Ozone Mapping Sensor (TOMS) has been cited by the MOT and the MODLAND Group as the principle source of column ozone data to use in correcting MODIS data for generating water and land leaving radiances. In previous ocean color remote sensing missions such as CZCS, the TOMS data have been used. These data are also being used by the AVHRR Land Pathfinder Project for atmospheric correction processing.

Since 1983, the TOMS data collected on NIMBUS 7 have been processed to produce a gridded Level 3 product, GRIDTOMS, which is a measure of the total columnar ozone. Daily global coverage was obtained by the TOMS on NIMBUS 7 allowing the processing to create a daily global product. This work has been done by the TOMS Ozone Processing Team (OPT) which is part of the Lab of Atmosphere (Code 916) at GSFC. They have processed all of the NIMBUS 7 TOMS data collected and have archived all useful GRIDTOMS products at NSSDC (which is now being incorporated as part of the GSFC DAAC). These data are available on 9 track tape(s) or two CD-ROMs from NSSDC. The OPT has also set up an anonymous ftp to distribute NIMBUS 7 TOMS products and will distribute the data on user supplied storage media.

When developing the GRIDTOMS Product, the OPT decided to generate a daily product that had the following product attributes:

1. A gridded product that contains column ozone values and reflectivity averages;
2. A global product that used an equal area map projection; and
3. A product that preserves the TOMS sensor pixel resolution as much as possible.

A series of TOMSs are scheduled to be flown within the next five years. In June 1994, a TOMS will be the payload on one of the Earth Probe Satellite Series being launched. A TOMS is also slated to be part of the payload on ADEOS I and ADEOS II, which will be launched in 1996 and 1999 respectively. Thus, if these satellites are deployed successfully, and the instruments operate nominally, TOMS data should be available through the year 2003.

Table C.02.2-1 Potential Sources of Ozone Data for Standard Processing

Input Product	GRIDTOMS	TITG03	O3 Total Burden	O3 Total Burden
SPSO Prod/Parm #s	N0005/552	N/A	MOD07/1333	AIR08/1332
Sensor Data	TOMS	SBUV/2	MODIS-AM1	AIRS-PM1
Sensor Platform	Nimbus 7,	POES	EOS-AM1	EOS-PM1
DAAC/ADC	GSFC DAAC	NOAA/NESDIS	GSFC	GSFC
Available from	1978	1990	1998	2001
To	2005	N/A	2003	2005
Daily Prod. Vol.	0.4 MBytes/day	N/A	0.4 Gbytes/day	0.004Gbytes/day
Units	Dobson Units	Dobson Units	Dobson Units	Dobson Units
Accur.Reported	+/- 1.3 % uncertainy	+/- 1%	+/- 30 DUs(abs.)	+/- 15 % (abs.)
Temporal Res.	Global/Daily	Global/Daily	Reg./Daily Global/weekly	Reg/Daily; Global/Weekly
Horizontal Res.	1 x 1.25 dg grid	200 x 200 km	5 km daily .5 x .5 degree/weekly	50 km x 50 km
Vertical Res (if applicable)	no atmos levels - column values	Both total col. and vertical levels are avail.	no atmos levels column values	no atmos. levels column values

Note: The notation "**N/A**", is used to mean the knowledge needed was ***not available***, and the notation "**n/a**" was used to mean that it was ***not applicable*** to that particular cell of the table.

C.02.3 Interface to Processing

The Columnar Ozone Product is used for atmospheric correction procedures for MODIS Level 1B Radiance Data. TOMS data have been used in the MOT heritage code for all CZCS processing. If the 1994 Earth Probe Launch is successful then continued use of the TOMS sensor on the Earth Probe is planned for the SEAWiFS Science Data Processing System (SDPS). This software is considered prototype code for the MODIS Water Leaving Radiances and it would be used to convert Level 1B Data to Water Leaving Radiances.

The MODLAND Group have also listed the TOMS data as the source for ozone data for their development work before launch. In the MODIS time frame they would like to use the MODIS product, MOD07, for their atmospheric correction processing. The AVHRR Land Pathfinder

software may be one source of prototype code to see how these data are implemented in the processing of land leaving radiances. This code is currently being run in the ECS Science Technology Lab (STL) and should be examined to learn more how the ozone data are used in this heritage software.

C.02.4 Ingestion Route

Currently, the SEAWiFS SDPS uses the anonymous ftp to ingest previous TOMS data for testing their system before the launch of SEAWiFS. The data are in ASCII format and a user must "pull" the data over the network in this format. SEAWiFS SDPS have the routines in their Level 2 Processing to interpolate the fixed gridded data into a form that is usable by their processing.

In the EOS era, these data sets should be readily available via the GSFC DAAC. The OPT have an agreement with the GSFC DAAC to distribute their Level 3 gridded product to the DAAC on a daily basis in HDF format. They will also maintain an anonymous ftp site on one their workstations where users can get the data if they desire.

C.02.5 Verification

The GRIDTOMS product is produced in hard copy form and distributed to the scientists responsible for developing the algorithms to generate the product. If anomalies are noted, the appropriate scientist(s) are notified and anomaly detection begins. In most instances anomalies detected can be corrected for the best possible correction within one week. The data are then reprocessed if the reprocessing will improve the particular GRIDTOMS product with the anomaly. If no correction can be done then (e.g., the chopper wheel filter of the sensor is working improperly), then the products are produced with the anomaly included.

C.02.6 Group Responsible for Development

The OPT plan on processing new TOMS data for the both the Earth Probe and the ADEOS missions. The MOT have concluded their SEAWiFS SPS as prototype code for generating their MODIS products. This software does contain the routines to ingest and process the ozone products.

C.02.7 Temporal Availability and Source Security

The OPT usually run one to two days behind in producing a level 3 product. For example, data collected onboard for one day are usually available within 24 hours after the OPT group has received that data from Wallops Island where it is currently down linked. In discussions with members of the OPT they have stated that the TOMS daily products are available on a daily basis 95 percent of the time. If they have problems with data transmission from the satellite to Wallops they will post a product that does not have global coverage. Once all of the data for a given day are received they will reprocess the data to produce a product with as much global coverage as possible. Even when there is problems in obtaining the data from the satellite, the OPT usually produce a product within two days after the data are collected.

As is listed above the OPT does make the data freely distributed via ftp or user supplied media. Also, an agreement between the OPT and the GSFC DAAC has been made so that the ozone products will be delivered to the DAAC on a daily basis.

C.02.8 Backup source(s)

In the EOS-AM1 time frame, the MODIS ST has listed the use of the MODIS Ozone Product (MOD07) as the principle ozone source to use in processing once it becomes operational. Once EOS-PM1 is launched and the AIRS Instrument is operating nominally, then another source of ozone data will be available. The AIRS ST will produce both a column ozone product and a product with ozone concentrations at four levels of the atmosphere (AIR08). NOAA/NESDIS also produces a daily global product using the SBUV/2 sensor on the POES Platform. They use the same processing algorithm as OPT, but create a product with ozone concentrations at different levels of the atmosphere. To date, the MODIS ST has used the total column ozone products for their heritage sensor work (AVHRR and CZCS) and have not listed whether an ozone product that has information in different layers of the atmosphere would be desired. The known characteristics of all three of these products are listed in Table C.02.2-1.

C.02.9 Schedule for Source, Ingestion Route and Associated Developments

If SEAWiFS code is available to the ECS Toolkit group, reviewing the code should provide insight on how the ingestion of the TOMS can be accomplished within the PGS environment. Again, MOT may only wish for the PGS Toolkit to provide the mandatory file I/O tool for them to use in their science software. Coordination with the other discipline groups of the MODIS ST is needed to find out their intentions for PGS Toolkit Implementation.

C.02.10 Testing

Currently, two CD-ROMs are available from NSSDC that contain TOMS Ozone data for approximately 13 years. Ozone data are also available via anonymous ftp. These data sources are adequate for test data.

C.03 Surface Climatology Data

C.03.1 Introduction

Surface Climatology Data are needed for generating of two Level 3 MODIS Products, a weekly composite of Daily Net Photosynthesis (MODIS Product number MOD17) and a product generated from making a composite of the weekly Photosynthesis Product, an Annual Net Primary Product (MODIS Product number MOD18). The surface climatology data needed are the following:

1. daily mean, maximum and minimum temperature;
2. daily precipitation;
3. daily incoming short-wave radiation;
4. daily cloud cover; and
5. daily relative humidity.

Clarification of the SPSO external options for this ancillary data set are needed.

C.03.2 Source and Source Data set Attributes

NMC Gridded Analysis Data appear to contain many of the parameters needed for these MODIS Level 3 Products. Exact content of the NMC fields needs to be defined further to ascertain if these fields will fill the requirements. Also the spatial resolution of the analysis data (approximately 2 x 2.5 degrees), may be too course for product development. DAO's GEOS Product is slated to have a spatial resolution of 1 x 1 degree by 1998 and this may be superior for use in generating these MODIS products. Table C.03.2-1 list other possible sources for these required parameters.

Table C.03.2-1 Potential Sources of Surface Climatology Data for MODIS Level 3 Processing

Input Product	COM.CED1.ANL.T0xx.FNL	DAO GEOS	ECMWF_MET
SPSO Prod/Parm #s	N0026/7	N/A	N0001/50, 217, 214,
Sensor Data	n/a	n/a	n/a
Sensor Platform	FNL	n/a	n/a
DAAC/ADC	NOAA/NWS	GSFC DAAC	ECMWF
Available from	Jan. 1990	June 1998	Jan. 1990
To	Jan. 2010	Jan. 2010	Jan. 2010
Daily Prod. Vol.	N/A	0.4 Gbyte/day	N/A
Units	varies w/ prod.	varies w/ prod.	varies w/ prod.
Accur.Reported	N/A	N/A	N/A
Temporal Res.	Global/Daily	Global/Daily	Global/Daily
Horizontal Res.	2 x 2.5 dg grid	1 x 1 dg grid (future)	2 x 2.5 degree grid.
Vertical Res (if applicable)	32-40 levels, (surface levels required)	32 levels, (surface levels required)	N/A

Note: The notation "**N/A**", is used to mean the knowledge needed was ***not available***, and the notation "**n/a**" was used to mean that it was ***not applicable*** to that particular cell of the table.

C.03.4 Interface to Processing

These data will be input into the Level 3 Processing of the MODIS LAI and NPP Prodcuts. The data should be in a gridded product format. Preprocessing of these data will be the same as other gridded data sets used in the processing (i.e., regridding, subsetting and interpolating). Clarification is needed as to whether these investigators will use the suite of ancillary data handling tools provided in the PGS Toolkit or if they will use their heritage SPS already developed.

C.03.4 Ingestion Route

See Section C.01.4. Ingestion Route of GAP.

C.03.5 Verification

The Q/C of NMC analysis data needs to be investigated. The use of routines developed by other members of the MODIS ST is possible. If NMC analysis data do not meet the product needs and DAO's GEOS product is used, verification of the input data will probably be done by DAO's product assurance procedures. More information is needed to determine what Q/C procedures the DAO plans on implementing.

C.03.6 Group Responsible for Development

The surface meteorological data needed by these MODIS ST should be part of the NMC analysis data and/or GEOS product. Tools to preprocess the surface meteorological data have been developed by these MODIS ST for their pre-EOS work. (development of products for regional areas of the U.S.). Use of PGS Toolkit tools may be limited to file O/I routines. They expect to deliver their SPS software with all necessary routines to implement their product at the EDC DAAC.

C.03.7 Temporal Availability and Source Security

NMC data is routinely produced because of its importance to global weather forecasting efforts. DAO data may be more efficient to use in the processing given co-location at GSFC DAAC and the same software management and product formatting. More work is needed in determining appropriate data to use for processing. Other sources for these data need to be identified. If other sources do exist, a decision by the ESDIS Project is needed concerning the support of the routine acquisition of such data.

C.03.8 Backup source

Backup sources may exist such as ECMWF Analysis Data. NMC and ECMWF analysis products are similar (more information needed), but there is a cost implication of ingesting these data. ESDIS Project guidance is required as input to determine if this backup source is feasible.

The EOS GEOS Assimilation Product could become the principle source once it becomes an operational product.

Instruments flying on PM-1, AIRS/AMSU, are also capable of producing certain surface climatology products needed (e.g., surface temperature). It is unclear whether the temporal resolution is fine enough for this product generation effort.

These ST Investigators have discovered from the MODIS ATBD Reviews, that certain MODIS Standard products will not meet their processing needs as originally thought, due to lack of availability of a global product in a timely manner (i.e., weekly product with global coverage).

C.03.9 Schedule for Source, Ingestion Route and Associated Developments

As with the GAP product, the preprocessing of the gridded analysis data could be a significant development, especially if common development SPS are involved covering several instruments. An early decision on the ingestion route for the Toolkit efforts should be made.

C.03.10 Testing

Obtaining a portion of the GEOS data currently being generated by the DAO may provide insight on how effective it is to use the assimilation data sets in this production stream. It also appears that the NCDC is starting to development a digital database for historic observation data. It may be applicable to obtain, a portion of this new database for prototyping activity.

C.04 MISR Surface Radiance Products

C.04.1 Introduction

The MISR Level 1B2 Surface Radiance Products (MIS03) are required in generating the MODIS Level 2 Bi-Directional Reflectance Distribution Function (BRDF) Products. The Product Numbers is the same for both, MOD09. One product is a BRDF with out topographic corrections (parameter number 3669), and the other does have topographic corrections applied (parameter 4332).

C.04.2 Source and Source Data Attributes

The MISR Level 1B2 Product is slated to be produced at the LARC DAAC on a daily basis for regions of the globe. This product will be generated at 275 meters (m) for regional areas and 1.1 km for the globe. Parameters for this product are listed in Table C.04.2-1 below.

Table C.04.2-1 Characteristics of MISR Level 1B2 Product

Input Product	MISR Surface Radiance Prod.
SPSO Prod/Parm #s	MIS03 / 4308
Sensor Data	MISR Radiances
Sensor Platform	EOS-AM1
DAAC/ADC	LARC DAAC
Available from	July, 1998
To	July, 2003
Daily Prod. Vol.	54.48 Gbytes/day
Units	Watt/m^2/sr/um
Accur.Reported	3% at equivalent RF of 1.0; 6% of equivalent RF of 0.05
Temporal Res.	Daily / 9 day Global
Horizontal Res.	275m - Regional 1.1 km -Global
Vertical Res (if applicable)	n/a

Note: n/a - not applicable

(source: MISR Level 1B2 ATBD and SPSO Database February, 1994)

C.04.3 Interface to Processing

Interfacing the MISR Surface Radiance Product with the MODIS Level 2 Products may require substantial preprocessing of the Surface Radiance Data to "co-register" these data with the MODIS Level 2 Surface Radiance Product (MOD09). Both products are scheduled to be in Space Oblique Mercator (SOM) Projects with a cell resolution of approximately 1.0 km. How the interpolation of the MISR Radiance Product will done is now the focus of the MODLAND Group. They have asked the MODIS Science Data Support Team (SDST) to develop processing scenarios for this product and to present those scenarios to the MODLAND Group. It is unclear if the PGS Toolkits will have the functionality included to handle this case.

C.04.4 Ingestion Route

The MISR Surface Radiance Product is slated to produced at LARC DAAC. From the Table listed in Section C.04.2 the daily volume is quite large which will probably nesitate proper sizing of communication lines between the LARC and GSFC DAACs.

C.04.5 Verification

How this Level 1B2 Product will be Q/C in a timely fashion needs TBD. It appears that MISR SPS developers with direction from the MISR ST Members will generate some Q/C of the product as it is produced. The amount and how stringent the Q/C will be needs TBD.

C.04.6 Group Responsible for Development

The MISR ST and their SPS developers are responsible for development of this product. They are working on prototype product structures at this time. More will be known about the Surface Product as the prototype efforts of the MISR ST progresses. The interface issues for using this product in MODIS processing is also under study by the MODIS SDST.

C.04.7 Temporal Availability and Source Security

These data should be available daily and their coincidence with the MODIS data collection make these data a required source for this product. Implications of not having these data readily available need further clarification (i.e., does MODIS product development stop while the MISR product development occurs)

C.04.8 Backup Source

These MODIS ST Members have not listed any backup sources for standard product generation. They have listed other sensor data as relevant data to use in prototyping product development. The data sets listed as candidate prototype data sets are ATSR-2 from ERS-2 Platform, POLDER from ADEOS-1 Platform and ASAS Aircaft Sensor Data. The coincidence with the MODIS sensor makes this MISR product the only feasible product to use in developing a BRDF product from MODIS data.

C.04.9 Schedule for Source, Integration Route and Associated Development

Prototyping of this data product has begun with candidate prototype data being obtained and processed. Geolocation of MISR and MODIS data could be significant preprocessing work for product development in EOS Era. As listed in Section C.03, the MODLAND Group have assigned the SDST to begin looking into this problem. More information should be available late Fall, 1994.

C.04.10 Testing

As listed in Section C.04.9 prototyping effort is beginning by SDST. Utility of PGS Toolkit Tools for this product's development can be tested by SDST after Fall, 1994 Toolkit Delivery.

C.05 MISR Aerosol Products

C.05.1 Introduction

The MISR Level 2 Aerosol (MIS05) are required in generating the MODIS Level 2 Bi-Directional Reflectance Distribution Function (BRDF) Products. The Product Numbers is the same for both, MOD09. One product is a BRDF with out topographic corrections (parameter number 3669), and the other does have topographic corrections applied (parameter 4332).

C.05.2 Source and Source Data Attributes

The MISR Level 2 Aerosol Product is slated to be produced at the LARC DAAC on a daily basis for regions of the globe. This product will be generated at 275 meters (m) for regional areas and 1.1 km for the globe. Parameters for this product are listed in Table C.05.2-1 below.

Table C.05.2-1 Characteristics of MISR and AVHRR Aerosol Products

Input Product	MISR Aerosol Products	TKTG01
SPSO Prod/Parm #s	MIS03 / 2299	n/a
Sensor Data	MISR	AVHRR Global aerosol observations
Sensor Platform	EOS-AM1	POES
DAAC/ADC	LARC DAAC	NOAA/NESDIS
Available from	July, 1998	January, 1990
To	July, 2003	January, 2010
Daily Prod. Vol.	No Estimate Available	0.706 Gbytes/day
Units	dimensionlness	optical depth units (ODUs)
Accur.Reported	0.05 for tau < 0.5 and 0.10 for tau > 0.5	0.03-0.05 ODUs
Temporal Res.	Daily / 9 day Global	weekly
Horizontal Res.	17.6km - Land 2.2 km -Ocean	1 x 1 Degree Global product (only 70 N/S)
Vertical Res (if applicable)	n/a	n/a

Note: n/a - not applicable, (source: for MISR Level 1B2 ATBD and SPSO Database

February, 1994; for AVHRR Product, NOAA/NESDIS Operation Product Tables Dated February 15, 1993)

C.05.3 Interface to Processing

Interfacing the MISR Aerosol Product with the MODIS Level 2 Products has the same issues as interfacing the MISR Surface Radiance Product with MODIS Level 2 data. These issues are listed in Section C.04.3. of this report.

C.05.4 Ingestion Route

MISR Aerosol Product is produced at the LARC DAAC as is the Surface Radiance Product. No product volume was given in the SPSO Databases. Again, any issues with ingesting this product are similar to the ones associated with the Level 1B2 Radiance Product of MISR.

C.05.5 Verification

How this Level 2 Product will be Q/C in a timely fashion needs TBD. The issues are similar to what has been listed in Section C.04.5.

C.05.6 Group Responsible for Development

The MISR ST and their SPS developers are responsible for development of this product. They are working on developing prototype code at this time. More will be known about this product's structure is defined further by the MISR ST.

C.05.7 Temporal Availability and Source Security

The MODIS ST Investigators need the MISR Product to increase the "robustness" of their product. They also plan on using the MODIS Aerosol Product (MOD04) in developing this product and more information is needed to determine the negative effect of not having the MISR Aerosol Product available for the generation of this product.

C.05.8 Backup Source

NOAA/NESDIS does produce a weekly aerosol product and these MODIS Investigators should have access to the MODIS Aerosol Product while generating this product. Whether the NESDIS Product (characteristics are listed in Table C.05.2-1 above) is a satisfactory replacement needs TBD.

C.05.9 Schedule for Source, Integration Route and Associated Development

Similar information and issues as are listed in Section C.04.9 of this Appendix.

C.05.10 Testing

As listed in Section C.04.9 the SDST is beginning to look into the use of MISR data in MODIS processing. Utility of PGS Toolkit Tools for this product's development can be tested by SDST after Fall, 1994 Toolkit Delivery.

C.06 Snow and Ice Cover

C.06.1 Introduction

The National Ice Center (NIC) weekly Sea Ice Product is needed for the MODIS Cloud Mask Product (MODIS Product number MOD02, parameter 3660) and for the MODIS Land Cover Product (MODIS Product number MOD12, parameter 2669). Clarification of SPSO external option numbers are needed. It may be met by SPSO number N0056.

C.06.2 Source and Source Data set Attributes

The NIC produces a routine product on a weekly basis using various satellite sources. Coverage of ice concentrations and thickness are the only products produced, no temperatures or emmissivities. Main output is hard copy but ice edge is digitized by NOAA for various areas including global weekly which is sent to NMC.

The ice product from NIC is produced from the analysis of SSM/I data (DMSP) and AVHRR data (POES). The weekly product varies in spatial resolution for each of the earth's hemispheres and there is a slight variation in coverage for each hemisphere. The smallest resolvable ice areas usually 20 x 20 km when the analysis system is running nominally and 40 x 40 km if the data for the week are not optimal.

C.06.3 Interface to Processing

This product will be used multiple times for MODIS processing and by other AM Instrument Teams for standard product development (e.g., see CERES Appendix). For MODIS, it is used in Level 1B processing for cloud mask development from MODIS Level 1B Radiances and again for Level 2 Processing in developing Land cover Product.

Instrument Teams should have software tools developed to ingest, interpolate and use these data in their processing given these same data have been used in ISCCP cloud detection work and are currently used in NOAA Operational cloud detection processing (Cloud AVHRR Algorithm - CLAVR).

The tools required for access are the same as those for other SURFMAP parameters (described in Section A.10 of the CERES Appendix) with the option for geographic searching provided by the PGS tool (TBC).

C.06.4 Ingestion Route

NIC digital products are currently not converted into a digital form in real time. NSIDC DAAC is going to become the single EOS distribution site in an agreement with NIC. Further investigation is needed to determine to investigate whether NSIDC DAAC can support the conversion of the data from hard copy to digital form in a timely manner.

C.06.5 Verification

TBD

C.06.6 Group Responsible for Development

MODIS Investigators will have software tools to use these data. ECS will supply tools, including geographic search if required. More information needs to be obtained concerning MODIS ST's planned use of PGS Toolkit.

C.06.7 Temporal Availability and Source Security

The hard copy product is produced reliably on a weekly basis. The question for standard processing is the timeliness in getting the weekly charts produced into a digital form.

C.06.8 Backup source

Appropriate backup sources are not obvious. Other satellite data such as SSM/I could supply the information although SSM/I is already an input to NIC. Higher quality products are probably available but not in a near-real-time mode. Table B.10.2 does list products from other EOS sensors such as MODIS and MIMR. Timeliness of regional products (for areas like Antarctica and the Arctic), from these sensors needs to be investigated to ascertain there utility in standard processing.

C.06.9 Schedule for Source, Ingestion Route and Associated Developments

See Section C.06.7

C.06.10 Testing

These data are available currently for testing, no problem is foreseen in using what will become the operational source for test purposes.

C.07 Land Surface Cover Product

C.07.1 Introduction

The Land Surface Cover product is needed for developing the MODIS cloud mask and by many of the MODIS Level 2 Land Surface Products (MOD08, MOD09 and MOD10). The SPSO external option is N0006.

C.07.2 Source and Source Data set Attributes

One source that is known to exist is the ecosystem database included on NGDC's Terrain Database CD-ROM. This data set is a global data set compiled from the EPA's Global Ecosystem data. NGDC has digitized this data set to include with their Terrain Ecosystem CD-ROM Package. The data set has been placed on a 10 x 10 minute latitude/longitude grid with the land areas of the globe classified into 59 ecosystems.

Another product being generated is the International Satellite Land Surface Climatology Project (ISLSCP) effort to develop a global land cover with a spatial resolution of 1 km x 1 km. This project is using the joint International Geosphere-Biosphere Program - NASA Pathfinder 1 km AVHRR data set that EDC DAAC is developing as the base data layer for their classification. The MODLAND group sees the development of this data set as a precursor to the Land Cover Product (MOD12). They plan on using this data set as baseline land cover product for their MODIS work. The ISLSCP Project is just getting started and it should be completed by late, 1996.

Other important data layers that will be developed as part of the ISLSCP Project, along with the land cover is the seasonal cover data layer (e.g., deciduous forests) and an albedo data layer for each given land cover category mapped. More information is needed to understand how both these data layers will be compiled and validated.

C.07.3 Interface to Processing

The MODIS ST sees this ancillary data set being used in MODIS Level 1B and Level 2 product development. They also see this product as not being static, but changes occurring to reflect the changes in seasonal vegetation cover. They do not feel they will be making weekly updates, but bi-weekly updates during the growing season for all substantially vegetated areas of the earth's surface.

C.07.4 Ingestion Route

The MODIS SDST plans on working with the EPA Ecosystem data set as starting point. They will incorporate any other useful data sets that are available for the rest of the earth's surface (e.g., EDC's land cover data sets for the continental US Data Sets). Funding levels for the 1 km EDC Product mentioned above and for pre-launch algorithm work will determine what data layer will be used at launch. These data will have to be staged for both Level 1B and 2 Data Processing if the initial description of the Cloud Mask stays as currently proposed.

C.07.5 Verification

The SDST plans on using the US EPA Ecosystem as a starting point and improving on this for land areas where better data exists.

C.07.6 Group Responsible for Development

Implementation of these data sets in standard processing needs more study. The MODIS and MISR Team's access to geographical referenced data sets such as land cover and DEM vary from other AM Instrument (i.e., swath oriented Level 2 Products). Further discussions are required to ascertain how Land Surface Data Sets (referenced as SURFMAP in the CERES Appendix) should be constructed for efficient processing. The PGS Toolkit will contain tools that allow basic manipulation of geo-referenced data sets (i.e., regridding, subsetting and interpolating).

C.07.7 Temporal Availability and Source Security

NGDC Ecosystem Data are available now and has been obtained by ECS PGS Group. It may be part of the October 1994 Toolkit release. The MODIS ST members will desire ESDIS to incorporate data sets of higher spatial resolution as they are developed. Members of the MODIS ST will be producing a high resolution surface product (1 km by 1 km) before launch and a standard product after launch (MOD12).

C.07.8 Backup source

Depending on progress of several efforts such as the ISLSCP 1 Km AVHRR Project should be completed prior to the launch of AM-1. Global NDVI data sets produced at NOAA/NESDIS is routinely produced but the quantification of these data sets to surface cover type is an extensive effort.

A 1 degree by 1 degree cover map has been produced by NASA researchers (Matthews, 1983) but this may not be of high enough spatial resolution for MODIS and MISR.

C.07.9 Schedule for Source, Ingestion Route and Associated Developments

Distributing the NGDC Ecosystem Data with the October 1994 PGS Toolkit delivery may be advantageous to help SPS developers understand how to interface and interpolate with this data set.

C.07.10 Testing

The appropriate set for testing will depend on the choice of operational data sets. Different DAACs such GSFC or EDC have archived material available.

C.08 Extraterrestrial Solar Irradiance Look Up Table

C.08.1 Introduction

These data are used in Level 2 processing to perform atmospheric corrections to the MODIS Level 1B Data to produce the water leaving radiances, (Product number MOD18, Parameter number 2416). It will also be used by the MODLAND Investigators producing MODIS Vegetation Indices (MVIs), (MODIS Product MOD12, Parameter number 2749). The SPSO External Option is N0014.

C.08.2 Source and Source Data Set(s) Attributes

These irradiance values have been developed by researchers who have measured the amount of solar irradiance reaching the top of the earth's atmosphere (Neckel and Labs, 1984). This table contains values from 300 to 1000 nanometers (nms) in 5 nanometer intervals. An effort will be made after the launch of the AM-1 Platform to develop a more specific table for the MODIS Instrument's bands. Its development will depend partially on the amount of vicarious calibration that can be done during the operation of the MODIS.

C.08.3 Interface to The Processing.

Used in developing water and land leaving radiances. The MOT have used this table in past ocean color remote sensing missions such as the CZCS. They are also planning on using it in the upcoming SEAWiFS Mission. In the software for the CZCS data, these irradiance data have been used in a look-up table (LUT) implementation. Actual size of this LUT is TBD, and its format may not be HDF if it is more efficient for processing to have the LUT in another format. The PGS Toolkit will have tools for SPS to open and close the file containing this table. The MOT has indicated that the actual indexing and weighting the irradiance values for the spectral bands of MODIS data being used to derive the water leaving radiances will be done with their heritage software. This computation will be done on a per pixel basis.

The MODLAND use of the PGS Toolkit with this LUT needs further clarification. Heritage software does exist for this group to use.

C.08.4 Ingestion Route

No ingestion of the table is needed except initially during the SPS integration and test effort.

C.08.5 Verification of the Ancillary Data

This has been done by members of the MOT for remote sensing missions such as CZCS and SEAWiFS.

C.08.6 Group Responsible for Development

The MOT is responsible for getting the table into the appropriate data archives (or data servers) for use in routine processing. Software to read this table and do any interpolation for MODIS data, will be done using the appropriate PGS Toolkit Call and software developed by the MOT data processing team (UN. of Miami Personnel), who are supporting the MOT in software

development. The MODIS SDST will be responsible to insure that the MOT software gets integrated correctly with the rest of the MODIS Level 2 software.

C.08.7 Temporal Available and Source Security

This LUT is in the published literature and has been put into a digital form by members of the MOT. It should be available via electronic transfer from the SEAWiFS Project or from the UN. of Miami MODIS Investigators.

If a new table is developed for the MODIS sensor, its development and implementation will be the responsibility of the MODIS Science Team (MST) members. This will include any software modifications to the SPS if the implementation of the LUT is different. If this effort is pursued, it probably will be a post launch activity.

C.08.8 Backup Source

The MISR Instrument Team will be using a different source for these data. They are using a LUT developed by the World Meteorological Center. This table includes a substantial portion of the Neckel and Labs Table.

C.08.9 Schedule for Source, Ingestion Route and Associated Developments

If possible, this table should be included with the PGS Toolkit Delivery in October, 1994. The PGS Toolkit Group or the ESDIS Project should make an effort to secure a copy of this LUT for this delivery.

C.08.10 Testing

The MOT should have prototype ocean color processing software available for a variety of PGS prototype efforts by late summer 1994. This software should be obtained as well as the LUT to test the nature of the processing of the water leaving radiance software. Most of the processing would be for performance issues as the table is a static data set and routine ingestion and pre-processing is not applicable.

C.09 Digital Elevation Model (DEM)

C.09.1 Introduction

The DEM data will be used in the Level 1A processing for Geolocation and Radiometric Corrections of the MODIS Data. These data will also be used in generating certain Level 2 Products. The SPSO External Option is N0009.

C.09.2 Source and Source Data Set Attributes

The MODIS ST hopes that the DMA's current holdings of the Digital Terrain Elevation Data (DTED) Level 1 data sets are released to the EOS Project. DTED Coverage exists for approximately 70 percent of the land areas of the globe. DTED has 90 meter horizontal resolution (i.e., grid spacing) for its DTED coverage of land areas found below 50 degrees latitude for both the Northern and Southern Hemispheres. The horizontal resolution varies in the longitudinal direction for land areas with DTED coverage found beyond 50 degrees latitude in both hemispheres. The vertical resolution is 30 meters for all of Level 1 DTED data.

Table C.01.2-1 list the topographic data requirements for the MODIS data as determined by the ST. It can be noted that the horizontal resolution of the DTED coverage found below 50 degrees latitude meets the requirements for all of the MODIS bands. The DEM requirements for the 250 and 500 meter bands (i.e., the principle bands being used to generate land surface products from MODIS). The horizontal spacing for longitudinal data beyond 50 degrees does not. The DTED coverage for all areas of the world meets the topographic requirements for the data products being produced from the 1 km bands of the MODIS Sensor.

Due to the lack of global coverage for DTED, the MODIS ST will have to rely on the CEOS effort, the GLOBE DEM Project, of which the USGS EROS Data Center (EDC DAAC) is a participating agency. The product being generated is a global DEM at 1 km horizontal resolution and various vertical resolutions depending on the land area being mapped. The attributes of this product are listed below. The MODIS ST has stated that their will be some degradation of the accuracy of standard products (starting with the Level 1A data product) if the DTED data are not available. At this time, they have not made estimates of the amount of degradation.

Table C.09.2-1 Topographic Data Requirements for MODIS Processing

Processing Step	MODIS Bands	Horizontal Resolution	Vertical Resolution	Slope Resolution
Orthophoto Generation	250 meter bands	500 meters	N/A	N/A
	500 meter bands	1000 meters	N/A	N/A
	1 km bands	2000 meters	N/A	N/A
Radiometric Correction	250 meter bands	100 meters	30 meters	1-3 degrees
	500 meter bands	100 meters	30 meters	1-3 degrees
	1 km bands	500 meters	100 meters	5 degrees
Geolocation	for all bands	TBD	30 meters	

(source: Gesch, D. 1993. "Topographic Data Requirements for EOS Global Change Research)

Table C.09.2-2 Characteristics Of DMA's DTED Level 1 Data

General Information: A uniform matrix of terrain elevation values for most land area of the world. The Level 1 product has post spacing of 3 arc seconds (approximately 100 meters). This density of points is equivalent to information provided by a map at a scale of 1:250,000.
Horizontal Datum: World Geodetic System 84.
Vertical Datum: Mean Sea Level
Contents of a Data Record: Each data record contains a cell header record which provides identification, administrative data, and information (parameters) required for the application, maintenance, and verification of the elevation values. Each elevation data record contains 1201 elevation values (in meters) along a single meridian. A cell will 201 to 1201 elevation data records depending on the appropriate latitude zone. In all of the five latitude zones, the latitude spacing of elevation values 3 arc seconds. The longitude spacing per zone is the following:
Structure of the Data Files: Matrix
Data File Format: ASCII labeled variable length records
Media: CD-ROMs now available. Also 9 track 6250 BPI Tape
Standard File Size: 1 by 1 degree geographic cell identified by its southwest corner coordinates
Accuracy: Accuracy statements are individually calculated for every product and provided in the Accuracy Header Record of a data file. Accuracy objectives are: Absolute Horizontal -50 meters at 90 percent circular error Absolute Horizontal -30 meters at 90 percent linear error
Coverage: DMA produces a time series of maps showing their coverage. New series are published periodically to show new coverage

(source: Digitizing The Future, Catalog of DMA Digital Data Sets 1991. DMA Stock # DDIPDIGITALPAC.)

Table C.09.2-3 Horizontal Resolution of DTED Level 1 Data.

Zone	Latitude	Longitude Spacing
1	0 to 50 Degrees N/S	3 arc seconds
2	50 to 70 degrees N/S	6 arc seconds
3	70 to 75 Degrees N/S	9 arc seconds
4	75 to 80 Degrees N/S	12 arc seconds
5	80 to 90 Degrees N/S	18 arc seconds

(source: Digitizing The Future, Catalog of DMA Digital Data Sets 1991. DMA Stock # DDIPDIGITALPAC.)

Other global DEMs exist or are in the process of being created. Existing global DEMs, such as ETOPO5, do not meet the requirements of the MODIS ST processing.

The DCW global DEM product being developed at the EDC DAAC, will provide elevation at 1 km resolution (30 arc seconds), with a vertical accuracy of at least +/- 650 m and often around +/- 100m. This product is currently being generated and so far around 25% of the land surface area of the globe has been completed. The product is slated to be completed by 1996.

NOAA/NGDC does distribute the only current global DEMs available as part of its Global Ecosystems Database via a CD-ROM. There is a 5 arc minute and 10 arc minute horizontal resolution data set produced by the DMA and U.S. Navy respectively. The 5 minute data set has an elevation expressed to within the nearest meter at each grid point, and the 10 minute data set having an elevation at the gird point expressed to within the nearest 30 feet.

Other areas of the world do have high resolution DEMs, but problems with incomplete coverage for a large continuous area (e.g., the U.S. 7.5 Minute Topographic Series has not been completely digitized), and high copyright fees for the use of the data (e.g., Western European Countries), will probably make these data unfeasible to use.

C.09.3 Interface to Processing

The Global DEM is needed for Level 1A Processing of the MODIS Data and for product generation of certain MODIS Level 2 Products (e.g., MOD09). The MODIS SDST will develop a suite of Geolocation algorithms that will be included in the Level 1 Processing of the MODIS data. They envision building 233 subsets of data from the Global DEM that will correspond to the 233 orbit tracks of EOS-AM1 Platform once it is launched. They plan on using this data set as part of their standard processing software for Level 1A and most likely will use the File Open/Close Tool that is provided by the PGS Toolkit to access these orbital DEMs from their Level 1A processing software.

The preparation of the 233 orbital DEMs will require a substantial effort by the MODIS SDST in the years before launch. The actual details of how this will be done are TBD. Another

processing implication that needs further study is how a filtering algorithm will be applied if the DTED data are made available and are incorporated into the Global 1 km DEM.

C.09.4 Group Responsible for Development

ECS will develop tools to access at least one general purpose global DEM as well as supplying the DEM. This tool will include search functionality based on lat/long calling parameters. The MODIS SDST will be responsible for developing their library of Orbit DEMs that their current PGS Operations Concept (DRAFT Document, dated 9/93). Schedule of development will depend on the completion of GLOBE DEM Project and the release of DTED.

C.09.5 Schedule for Development

The initial development and release of the PGS Toolkit geolocation tools will take place during early May, 1994. Given the MODIS ST and SDST plans for a set of orbital DEMs the PGS Geolocation Tools probably will not be applicable to their processing. SDST should begin building the orbital DEMs and the tools to manipulate them by the Fall of 1994.

C.09.6 Testing

EDC will finish portions of the GLOBE DEM by mid-1995. If DTED is released it will allow the MODIS SDST personnel to begin to build the appropriate orbital DEMs needed and to develop their filtering program to filter the DTED data for the 1 km simulated data for MODIS (the simulated data will be from the 1 km AVHRR Pathfinder Data Sets).

C.10 Global Ground Control Points (GCPs)

C.10.1 Introduction

A set of GCPs would be used to check the accuracy of the Level 1A Geolocation Processing. The SPSO external option is N0045.

C.10.2 Source and Source Data Set Attributes

The MODIS SDST has identified the Landsat Control Point Chips as a possible source for this GCP Library. EDC DAAC Personnel are in the process of developing a White Paper on this library and the report should list the needs of other AM Instruments such as MISR and ASTER.

The DMA does have a product called World Mean Elevation Data (WMED). Its distribution needs TBD. The characteristics of the DMA WMED are given in Table C.10.2-1 listed below.

Table C.10.2-1. Characteristics of DMA's World Mean Elevation Data Set

Ground Point Density: The standard unit for WMED depiction is a nominal 12 by 18 nanometer world area grid (WAG) cell. There are 400 WAG cells corresponding to the geographic limit of each parent World Aeronautical Chart (WAC).
Coordinate Reference System: Geographic
Horizontal Datum: World Geodetic System 84.
Vertical Datum: Mean Sea Level
Content: Elevation data (in meters) are collected for those WAG cells that are interior to continent of island. A WAG cell covering less than 50 percent ocean surface is considered interior to the land mass. The preferred source is DTED. In areas with no DTED coverage, the best small or medium scale cartographic source is used. As additional DTED coverage is produced, updated WMED will be generated and made available to users on a quarterly basis. Data collected for each cell include: - Minimum elevation value (low) - Maximum elevation value (high) - Arithmetic Mean elevation - Standard deviation - Source - Absolute vertical accuracy **Note**: In the case of cartographically-derived data, the standard deviation cannot be defined and that field is left blank. Some areas where contours on the cartographic source preclude interpretation of minimum and maximum values, the minimum, maximum, and mean elevation will be single value interpolated from surrounding WAG cells.
Structure: Textual listing by WAC/200/WAG cell
Format: ASCII 132 character records with 25 records per block and a variable number of blocks per file. No standard file size
Distribution Media: 9 track tape, 6250 BPI (as of 1992)
Accuracy: Source and absolute vertical accuracy information provided as apart of the data for each WAG cell.
Area Coverage: Worldwide

(source: Digitizing The Future, Catalog of DMA Digital Data Sets 1991. DMA Stock # DDIPDIGITALPAC.)

The DMA's Digital Chart of the World or the World Vector Shoreline Data Sets may partially fill this need. Currently these data sets are available through federal government agencies such as NOAA NGDC or USGS and from private vendors. Both data sets have worldwide coverage and the accuracy of either source varies with location and with the data source used in compiling each product.

C.10.3 Interface to Processing

The SDST plans on using the GCPs to do sample checks on their geolocation processing. They plan on making this process automated so that no operator is required to monitor this effort during routine processing at the GSFC DAAC. More information will be forthcoming on this processing with the peer review of MODIS ATBD for Geolocation (a draft version of this ATBD is due the out at the beginning of June, 1994). Actual work on the tools will probably not start until the Fall of 1994.

C.10.4 Group Responsible for Development

The SDST will be responsible for developing this GCP Library (which may be a set of image chips) over time for MODIS standard Level 1A processing. This may become an issue for the ESDIS Project because other AM Instrument Teams, especially ASTER, would like access to this type of library for their standard product processing.

C.10.5 Schedule for Development

EDC DAAC personnel are currently investigating the quality of the Landsat GCP Library. Their initial investigation has resulted in a conclusion that this GCP Library may be adequate for MODIS, but not for the ASTER Instrument Team needs. The MODIS SDST Team will begin work on prototyping their geolocation tools in the Fall 1994.

C.10.6 Testing

Assessment of the EDC Landsat GCP Library is ongoing and a draft White Paper is due in May-June, 1994 time frame. If adequate for MODIS processing, the Landsat GCP Library will be available for the SDST to being work with it. The SDST plans on obtaining more Landsat TM scenes if this Library needs more data. They expect to have some rudimentary tools ready for the beta delivery in 1995.

C.11 Land/Sea Mask

C.11.1 Introduction

The Land/Sea Mask is needed for generating the MODIS cloud mask and by some of the MODIS Level 2 Land Surface Products (MOD08, MOD09 and MOD10). The SPSO external option is N0007.

C.11.2 Source and Source Data set Attributes

Several products are available such as DMA's Digital Chart of the World (DCW) and the CIA's World database II (WDB II). Both are in digital format and available at low cost or freely available through anonymous ftp.

C.11.3 Interface to Processing

The MODIS ST sees this ancillary data set being used in the MODIS Level 1B Cloud Mask processing and in the Level 2 Land Cover Product processing product development.

These data may also be used as part of the quality check on Level 1A Geolocation processing a part of the automatic checks associated with the GCP Chips.

If these data sets have been converted to raster images, PGS Toolkit Tools developed for other raster data sets may be applicable for use with these data sets.

C.11.4 Ingestion Route

These data will reside at the DAACs where MODIS data are being processed (these data sets are already part of the Version 0 Pathfinder and IMS Efforts). No real ingestion is needed for EOS Time frame.

C.11.5 Verification

All global data sets appear to have varying quality at different areas of the globe. SEAWiFS Project is using the DMA's World Vector Shoreline (WVS) data set which was compiled from 1:250,000 scale map sheets for the world. It is unknown if any effort will be made to produce the most accurate product available from all known source data by the EOS-AM Time frame. It also must be ascertained whether any of these data sets take into account the tidal effect for coast lines which may occur for select overpasses during the EOS-AM mission.

C.11.6 Group Responsible for Development

Similar development as is listed in Section C.10.6 of this Appendix.

C.11.7 Temporal Availability and Source Security

The DCW product of NGDC CD-ROM is being used by PGS Toolkit Development Group already and will be included as part of October, 1994 Toolkit Delivery. The CIA WDB II is freely available.

C.11.8 Backup source

The CIA WDB II data base is freely available. Efforts to get the WVS product from the SEAWiFS Project should be made.

C.11.9 Schedule for Source, Ingestion Route and Associated Developments

Distributing the DCW Data with the October,1994 PGS Toolkit delivery may be advantageous to help SPS developers understand how to interface and interpolate with this data set.

C.11.10 Testing

Data sets are available for testing. Effort to understand how the AVHRR Land Pathfinder Group have effectively used these data needs to be investigated. Use by the SEAWiFS Project of the WVS Product should also be investigated to see if better results were obtained versus other global data sets.

C.12 Global Soil Database Product

C.12.1 Introduction

A global soils database is needed for generating two Level 3 MODIS Products, a weekly composite of Daily Net Photosynthesis (MODIS Product number MOD17) and a product generated from making a composite of the weekly Photosynthesis Product, an Annual Net Primary Product (MODIS Product number MOD18).

C.12.2 Source and Source Data Set(s) Attributes

One source for this database is the ISLSCP effort being done at the EDC DAAC. EDC personnel have taken an earlier digitized version of the Food and Agriculture Organization (FAO) of the United Nations and have reformatted the data to some extent. The original data were compiled during the 1960's and 1970's using both existing maps and limited field checks. The FAO Project was forced to use base maps with limited soils information. The ISLSCP product is known as GLOBTEX and it is currently being completed by EDC personnel. The database as a spatial resolution of 1 x 1 degree for the global land areas. The data will be distributed on a variety of storage media for a nominal fee.

C.12.3 Interface to Processing

The MODIS ST Members will use the soils database when running their model to create the Level 3 Products. These data will be part of the data layers used in determining the NPP for a given time period. They currently have the software to process the soils data and will probably include SPS to do the necessary manipulation of these data in generating their planned MODIS products. Information concerning the planned use of PGS Toolkit's Ancillary Data Tools need TBD.

C.12.4 Ingestion Route

These data will reside at the DAACs where MODIS Level 3 data are being processed (EDC) and should easy to integrate into the processing.

C.12.5 Verification

The FAO Soils Database is becoming outdated. An international effort is underway to develop a replacement data set. This effort is known as, the Soil and Terrain (SOTER) digital database of the world is being undertaken by different international resource agencies. A completion for this effort is TBD.

The FAO Database has limited accuracy and confidence information available for the different layers of information.

C.12.6 Group Responsible for Development

If the MODIS ST Members generating these MODIS products know of any more updated or robust databases of global soils data they should let groups such as SDST or the ESDIS Project know of their existence. Time frame of completing the new SOTER Database needs further investigation.

C.12.7 Temporal Availability and Source Security

The FAO Database will exist at EDC and use in processing should not be a problem. PGS Toolkit should have necessary tools to handle these data in processing.

C.12.8 Backup source

No other global soils database is known at this point. Staying current with the development of the SOTER Effort should be done.

C.12.9 Schedule for Source, Ingestion Route and Associated Developments

An understanding of how this MODIS Investigation uses the regional soils database in their work now should provide insight in how these soils data will be used for MODIS processing efforts.

C.12.10 Testing

The soils database should be available for ECS PGS Toolkit Group to obtain. Distribution with other NGDC Terrainbase data sets should be considered for Fall, 1994 PGS Toolkit delivery.

C.13 Conclusions

C.13.1 Critical Dependencies and Sources

Two critical dependencies for non-EOS and EOS data that are unique to MODIS processing is the surface climatology data and the MISR Surface Radiance Product. Without having daily surface climatology routinely available, the accuracy of the daily net photosynthesis product will be degraded to some degree. A backup source for the MISR surface radiance data needs to be identified since it will probably take some time after launch for the MISR product to become operational.

C.13.2 Implications for PGS Toolkit Ancillary Data Handling Tools

Many of the MODIS Investigators have heritage software to handle the preprocessing of the ancillary data identified in this appendix. It appears that certain groups, such as the MOT plan on using their own software for preprocessing ancillary data into a form needed by their SPS. The use of the ADH tools depends on the "robustness" of the tools developed. The scope of the ADH Tools, is currently being defined during June and July, 1994. The initial ADH tools will be included in the Fall, 1994 PGS Toolkit Delivery.

C.13.3 Implications for PGS Pre-Processing and ECS Interfaces

The Q/A of ancillary data sets used in standard processing needs to be defined. Before that, understanding the Q/A done by the producing entity may help reduce concern of data quality that has been voiced by various AM-1 Teams. If Q/A issue is resolved this may reduce operation efforts in the PGS and the amount of preprocessing required for the various ancillary data sets.

The use of MISR Level 2 data in standard processing for MODIS may require extensive manipulation of the MISR data due to the swath based nature of Level 2 MSIR products. This is one of the prototypes scheduled to be done by the MODIS SDST group.

C.13.4 Outstanding Issues

For the MODIS ST the outstanding issues for their standard processing are:

1. Surface climatology and soils database ancillary data sets need to added to the SPSO list of non-EOS data needed for Standard processing;
2. The global DEM requirements for MODIS processing requires the use of Level 1 DTED Data. If these data are not available some degradation of MODIS land surface products will probably occur.
3. The MODIS higher level products (in particular the daily net photosynthesis and the BDRF products) need many lower Level 2 MODIS products and some Level 2 MISR products. Suitable backup sources need to be identified for these lower Level 2 products and MISR data to insure the MODIS data can be processed to the slated product levels. These backup sources need to be identified before the ESDIS Project makes an initial

decision of ancillary data sets to support for standard processing (tentatively slated to be made in November of 1994).

4. The use of buoy data from various sources needs further investigation. Initial contact made with members of the MOT have indicated that these data will be used for validation of higher level products and calibration of the Level 1B radiances. The MOT has the desire to move these processes to operational DAACs after they have had time to automate the process to the degree possible, and to fine tune the actual procedures implemented. They obtain these data from various NOAA sources and from international government agencies (e.g., Canadian government agencies). These sources must be identified and the data needed by the MOT characterized to ensure that the appropriate interfaces are developed.

Appendix D MISR

Introduction

The MISR processing for standard products has similar needs to that of the MODIS Team. Therefore, much of the discussion found in Appendix C also applies to this chapter. The MISR Science Team (ST) current thinking includes some different processing techniques and this results in the use of the same ancillary data set in a somewhat different manner. The ST is also rethinking what ancillary and EOS data they will use in their MISR processing and may negate some of the material presented in this appendix. Also, they are planning on using the classification masks that were slated to be produced in the Level 1B processing of MODIS data. Because the MODIS ST is currently redefining their Level 1B processing it is unclear whether the classification masks will be part of the Level 1B product finally specified. Hence, two ancillary data products are included in this text to cover the MISR Team's requirements.

D.01 Gridded Analysis Product (GAP)

D.01.1 Introduction

The Gridded Analysis Data produced by organizations such as NOAA's National Meteorological Center (NMC) are required in MISR standard product processing when applying atmospheric correction software to Level 1B1 data to produce the Level 2 Aerosol Product (AP). The MISR ST have also noted the requirement for surface wind data from GAP to use in generating the Level 2 Surface Radiances for ocean areas. The SPSO external option is N0001.

The GAP parameters needed are the following:

1. surface pressure;
2. temperature and water vapor profiles, (including surface levels);
3. relative humidity; and
4. surface winds over the ocean.

The MISR ST, also have a requirement for GAP data that uses scatterometer data as an input into the derivation of surface winds over global ocean areas. To date, the ECMWF seems to be one of the few organizations that produces GAP data in an operational environment which includes wind field products from a satellite borne scatterometer. If this is not feasible due to potential cost of ECMWF data, they would like the ESDIS Project to support the ingestion of scatterometer wind products from other satellite platforms such as ERS-2 or ADEOS-I and II.

D.01.2 Source and Source Data set Attributes

GAP characteristics from NOAA/NMC need further defining as far as the gridding and formatting information. More information is also needed about the ECMWF GAP data. If ESDIS Project does support the routine ingestion of scatterometer wind products, then the characteristics of the NSCAT wind products from the ADEOS I and II Platforms are also needed.

D.01.3 Interface to Processing

The GAP data will be used in the Level 2 AP processing to remove atmospheric attenuation found in the Level 1B1 data. At the moment, it appears the PGS Toolkit will need to support the MISR Science Data Processing Team (SDPS) with similar preprocessing tools as are needed for CERES and MODIS Teams. These tools would be utilized to incorporate and use GAP data in their processing (i.e., regridding, subsetting and interpolating tools,).

D.01.4 Ingestion Route

Ingestion of NMC for MISR Processing will not be any different from what is being done for MODIS, hence the summary given in Chapter 4, Section 4.01.4, would apply to what the MISR SDPT needs.

D.01.5 Verification

Information is needed and is being sought to understand how quality assurance (Q/A) of ancillary data such as NOAA NMC GAP is done in an operational environment. This is needed by the ECS PGS Group to help them understand the level of Q/A of the data that the ECS will be ingesting for standard processing. The MISR ST members would also like clarification concerning the ECS plans on the Q/A of NMC Analysis Data.

D.01.6. Group Responsible for Development

The MISR ST would like to know to what extent the PGS Toolkit will support the preprocessing (i.e., regridding, subsetting and interpolating) of NMC data. PGS Toolkit personnel are planning to provide more functionality as far as ancillary data handling in the next Toolkit delivery. The Toolkit Group is in the design phase of ancillary data handling tools for the PGS Toolkit. More information should be available during late summer 1994.

D.01.7 Temporal Availability and Source Security

NMC data is routinely produced because of its importance to global weather forecasting efforts. These data should be available on a regular basis. Again the discussion presented in Chapter 4, Section 4.01.7 is applicable to MISR processing.

D.01.8 Backup source

One potential backup source is ECMWF. The MISR Team would like ESDIS Project to support this GAP because of the use of scatterometer wind products in the derivation of surface wind products over the ocean. ECMWF products are similar (more information needed) to NMC

products, but there is a cost implication of ingesting these data. ESDIS Project guidance is needed if this backup source is required.

The EOS GEOS Assimilation Product may become the routine source for ancillary data once this product becomes operational. The acceptance of this product by the MISR Team is TBD. The early GEOS model is being produced daily by the DAO at GSFC. Its use in prototype code could provide value information on the utility of the GEOS models for atmospheric parameters required for standard processing in the EOS AM-1 era.

Fleet Numerical Operations Center (FNOC) also produces an analysis product which is archived at NCDC. Availability of this product within 24 hours needs further clarification. These data have been used by the certain MODIS Investigators in the past for the CZCS mission. Whether these data satisfy the other AM Instrument Teams is TBD.

Surface wind fields generated from scatterometers scheduled to fly on various satellites during the latter part of the 1990's. The MISR ST have stressed the requirement for these data to be used in standard processing either in some analysis product or as a stand alone product.

Instruments flying on PM-1, AIRS/AMSU, are also capable of producing atmospheric temperature and humidity profiles and surface pressure data.

The Table found in Section A.07 of Appendix A of this Discussion Paper provides more information about each of the potential backup sources listed above and other potential backup sources.

D.01.9 Schedule for Source, Ingestion Route and Associated Developments

The preprocessing of the gridded analysis data could be a significant development, especially if common development covering several instruments is undertaken. An early decision on the preprocessing functionality the PGS Toolkit will support and the ingestion route for the Toolkit efforts should be made.

D.01.10 Testing

Obtaining selected data sets of GAP should be done for prototyping efforts. Using the ftp mechanism that DAO and the SEAWiFS Project use to obtain GAP should be investigated. Certain data sets of NMC GAP data are archived at NCDC, obtaining selected subsets from NCDC can also be done for test purposes.

D.02 Total Column Ozone

D.02.1. Introduction

The total column ozone data are used in Level 2 AP generation to remove atmospheric attenuation from the MISR radiances. These data are needed when ozone column con The SPSO external option is N0005.

D.02.2 Source and Source Data Set(s) Attributes

Table D.02.2-1 list several sources of ozone product data in the EOS-AM1 time frame. To date, processed data from the Total Ozone Mapping Sensor (TOMS) has been cited as one possible source by the MISR SPS developers.

Since 1983, the TOMS data collected on NIMBUS 7 have been processed to produce a gridded Level 3 product, GRIDTOMS, which is a measure of the total columnar ozone. Daily global coverage was obtained by the TOMS on NIMBUS 7 allowing the processing to create a daily global product. This work has been done by the TOMS Ozone Processing Team (OPT) which is part of the Lab of Atmosphere (Code 916) at GSFC. They have processed all of the NIMBUS 7 TOMS data collected and have archived all useful GRIDTOMS products at NSSDC (which is now being incorporated as part of the GSFC DAAC). These data are available on 9 track tape(s) or two CD-ROMs from NSSDC. The OPT has also set up an anonymous ftp to distribute NIMBUS 7 TOMS products and will distribute the data on user supplied storage media.

When developing the GRIDTOMS product, the OPT decided to generate a daily product that had the following product attributes:

1. A gridded product that contains column ozone values and reflectivity averages;
2. The global product that used an equal area map projection; and
3. A product that preserves the TOMS sensor pixel resolution as much as possible.

A series of TOMSs are scheduled to be flown within the next five years. In June 1994, a TOMS will be the payload on one of the Earth Probe Satellite Series being launched. A TOMS is also slated to be part of the payload on ADEOS I and ADEOS II, which will be launched in 1996 and 1999 respectively. Thus, if these satellites are deployed successfully, and the instruments operate nominally, TOMS data should be available through the year 2003.

Table D.02.2-1 Potential Sources of Ozone Data for Standard Processing

Input Product	GRIDTOMS	TITG03	O3 Total Burden	O3 Total Burden
SPSO Prod/Parm #s	N0005/552	N/A	MOD07/1333	AIR08/1332
Sensor Data	TOMS	SBUV/2	MODIS-AM1	AIRS-PM1
Sensor Platform	Nimbus 7,	POES	EOS-AM1	EOS-PM1
DAAC/ADC	GSFC DAAC	NOAA/NESDIS	GSFC	GSFC
Available from	1978	1990	1998	2001
To	2005	N/A	2003	2005
Daily Product Volume	0.4 MBytes/day	N/A	0.4 Gbytes/day	0.004Gbytes/day
Units	Dobson Units	Dobson Units	Dobson Units	Dobson Units
Accuracy Reported	+/- 1.3 % uncertainty	+/- 1%	+/- 30 DUs(abs.)	+/- 15 % (abs.)
Temporal Resolution	Global/Daily	Global/Daily	Reg./Daily Global/weekly	Reg/Daily; Global/Weekly
Horizontal Resolution	1 x 1.25 deg grid	200 x 200 km	5km daily .5 x .5 degree/weekly	50 km x 50 km
Vertical Resolution (if applicable)	no atmos levels - column values	Both total column and a product with vertical levels are avail.	no atmos levels- column values	no atmos. levels- column values

Note: The notation "**N/A**", is used to mean the information needed was ***not available***, and the notation "**n/a**" was used to mean that it was ***not applicable*** to that particular cell of the table.

D.02.3 Interface to Processing

The ozone data will be used for removing atmospheric attenuation from the Level 1B2 to produce to produce the AP. The ozone data will have to undergo the same preprocessing as the GAP data in order to be used in the processing, hence the same PGS Toolkit tools are required (i.e., regridding, subsetting and interpolating).

D.02.4 Ingestion Route

In the EOS era, TOMS data sets should be readily available via the GSFC DAAC. The OPT have an agreement with the GSFC DAAC to distribute their GRIDTOMS to the DAAC on a daily basis in HDF format. They will also maintain an anonymous ftp site where users can get these data if they desire. The communication lines between the GSFC and LARC DAACs will need to be sized appropriately to insure timely deliveries.

D.02.5 Verification

A hard copy of the GRIDTOMS daily product, is produced and distributed to the scientists who developed the algorithms to generate the ozone product. If anomalies are noted, the appropriate scientist(s) are notified and anomaly detection begins. In most instances, anomalies detected can be corrected for the best possible correction within one week. The data are then reprocessed if the reprocessing will improve the daily products with the anomaly. If no correction can be done (e.g., the chopper wheel filter of the sensor is working improperly), then the products are produced with the anomaly included.

D.02.6 Group Responsible for Development

The OPT plans on processing new TOMS data for both the Earth Probe and the ADEOS missions. The GRIDTOMS product will be available in both HDF and the OPT standard format (i.e., a flat ASCII file). A decision as to which format to routinely ingest will need to be made by the MISR ST if they decide to use the TOMS data in their standard processing.

D.02.7 Temporal Availability and Source Security

As is listed above the OPT does make the data available via ftp or user supplied media. Also, an agreement between the OPT and the GSFC DAAC has been made so that the ozone products will be delivered to the DAAC on a daily basis.

D.02.8 Backup source(s)

In the EOS-AM1 time frame, the MISR ST plans on using the MODIS Ozone Product (MOD07) once it becomes an operational product. Once EOS-PM1 is launched and the AIRS Instrument is operating nominally, then another source of ozone data will be available. The AIRS ST will produce both a column ozone product and a product with ozone concentrations at four levels of the atmosphere (AIR08).

NOAA/NESDIS also produces a daily global product using the SBUV/2 sensor on the POES Platform. They use the same processing algorithm as OPT, but create a product with ozone concentrations at different levels of the atmosphere. The known/tentative characteristics of all three of these products are listed in Table D.02.2-1.

The processing of SAGE-II data also creates a global ozone product that may also be suitable for standard processing. More information concerning that product's characteristics can be found in Section B.05 of the this report. The SAGE data products will be one of the products supported by Version 0 Activities of the LARC DAAC.

D.02.9 Schedule for Source, Ingestion Route and Associated Developments

The preprocessing tools required for handling gridded Level 3 ozone data are similar to the requirements for preprocessing GAP data, (e.g., regridding and interpolating). See section D.01.9 for more information.

D.02.10 Testing

Currently, two CD-ROMs are available from NSSDC that contain TOMS Ozone data for approximately 13 years. Ozone data are also available via anonymous ftp. These data sources are adequate for test data.

D.03 Land Surface Cover Product

D.03.1 Introduction

The Land Surface Cover product is needed for developing the TOA and Cloud Product and it may be used in developing the Level 1B2 AGP Product. This product is being listed as a replacement for the MODIS Classification Masks that were to be generated a part of the MODIS Level 1B processing of MODIS data. The SPSO external option is N0006.

D.03.2 Source and Source Data set Attributes

One source that is known to exist is the ecosystem database included on NGDC's Terrain Database CD-ROM. This data set is a global data set compiled from the EPA's Global Ecosystem data. NGDC has digitized this data set to include with their Terrain Ecosystem CD-ROM Package. The data set has been placed on a 10 x 10 minute latitude/longitude grid with the land areas of the globe classified into 59 ecosystems.

Another product being generated is the International Satellite Land Surface Climatology Project (ISLSCP) effort to develop a global land cover with a spatial resolution of 1 km x 1 km. This project is using the joint International Geosphere-Biosphere Program - NASA Pathfinder 1 km AVHRR data set that EDC DAAC is developing as the base data layer for their classification. The ISLSCP Project is just getting started and it should be completed by late, 1996.

Other important data layers that will be developed as part of the ISLSCP Project, along with the land cover is the seasonal cover data layer (e.g., deciduous forests) and an albedo data layer for each given land cover category mapped. More information is needed to understand how both these data layers will be compiled and validated.

D.03.3 Interface to Processing

The MISR ST plans on using this data set in their cloud product processing. These data will be used to supplement the AGP in the generation of the cloud product.

D.03.4 Ingestion Route

The MISR ST current plan is to get this data set staged at the LARC DAAC. Pre-launch work may include working with the EPA Ecosystem data set as starting point. They will incorporate any other useful data sets that are available for the rest of the earth's surface (e.g., EDC's land cover data sets for the continental US Data Sets). Funding levels for the 1 km EDC Product mentioned above and for pre-launch algorithm work will determine what data layer will be used at launch. This ancillary data will have to be subsetted to the swath area of the MISR data. Substantial pre-processing of this ancillary data may be needed (i.e., subsetting and regridding).

If the MODIS Land Cover Product slated to be developed post launch is operational the MISR ST may want to use this product in their processing. If so, pre-processing may be substantial to get the two swath oriented products to overlap in coverage. Again, as the MISR ST refine their

product development strategy more information on the use of any land surface cover product should be available.

D.03.5 Verification

Information on the utility of existing data sets such as NOAA/NGDC Ecosystem Product need to be verified with the MISR ST.

D.03.6 Group Responsible for Development

Implementation of these data sets in standard processing needs more study. The MODIS and MISR Team's access to geographical referenced data sets such as land cover and DEM vary from other AM Instrument (i.e., swath oriented Level 2 Products). Further discussions are required to ascertain how Land Surface Data Sets (referenced as SURFMAP in the CERES Appendix) should be constructed for efficient processing. The PGS Toolkit will contain tools that allow basic manipulation of geo-referenced data sets (i.e., regridding, subsetting and interpolating).

D.03.7 Temporal Availability and Source Security

NGDC Ecosystem Data are available now and has been obtained by ECS PGS Group. It may be part of the October, 1994 Toolkit release. As the MISR ST refine their processing strategies more will be known about their need for land surface data. Whether the NOAA/NGDC CD-ROM data meet their resolution requires is TBD.

D.03.8 Backup source

Depending on progress of several efforts such as the ISLSCP 1 Km AVHRR Project should be completed prior to the launch of AM-1. Global NDVI data sets produced at NOAA/NESDIS is routinely produced but the quantification of these data sets to surface cover type is an extensive effort.

A 1 degree by 1 degree cover map has been produced by NASA researchers (Matthews, 1983) but this may not be of high enough spatial resolution for MISR.

D.03.9 Schedule for Source, Ingestion Route and Associated Developments

Distributing the NGDC Ecosystem Data with the October 1994 PGS Toolkit delivery may be advantageous to help SPS developers understand how to interface and interpolate with this data set.

D.03.10 Testing

The appropriate set for testing will depend on the choice of operational data sets. Different DAACs such GSFC or EDC have archived material available.

D.04 Stratospheric Aerosols

D.04.1 Introduction

Stratospheric Aerosols are need in generating the MISR AP. The SPSO external reference N0004.

D.04.2 Source and Source Data set Attributes

Listed in Table D.04.2-1 is possible sources of this product. In the EOS era (currently post AM-1 launch) the SAGE III Instrument is slated to generated such a product.

Table D.04.2-1 Sources of Information on Aerosol Products Being Generated From Various Earth Observing Satellites

Input	SAG02	EOS3	ILAS_AER	POAM_AER	SCIA_AER
parm #	1012	2297	917	917	917
Parm/Product Name	Aerosol Extinction Profiles (at 7 wavelengths)	Aerosol Optical Thickness	Aerosol	aerosol	aerosol
Other name	Aerosol Extinction Profiles (at 7 wavelengths)	Aerosol Optical Thickness	0		0
Instrument	SAGE-III	EOSP	ILAS	POAMIII	SCIAMACHY
Platform	AERO,CHEM	AM2	ADEOSI	NRL	EnviSat
DAAC/ADC	LaRC	LaRC	Japan	?	ESRIN
from	Jun-2002	Jun-2002	Jan-1996	Jan-1996	Jan-1998
to	Nov-2007	Nov-2007	Jan-1999	?	Jan-2001
GB/day	0.0004	0.016	?	?	?
Units	/km	dimensionless	?	?	?
Accuracy (Abs:Rel)	5% :: 5%	0.05 :: 10%	?	?	?
Temporal Res.	1/(2 min), 30/day	1/day [d]	?	?	?
Horizontal Res:Cover	<2 x <1 dg :: G	40 km :: G	?	?	?
Vertical Res:Cover	1 km :: 0-40 km	Column :: Atmos	4km::?	?	?

Primary sources are SAGE II and SAGE III. SAGE II is currently operational as a NASA provided instrument on a NOAA platform (ERBS). It is cited as serving the TRMM and EOS-AM missions until the launch of SAGE III. However, SAGE II is currently beyond it's life expectancy and will not last until 1997. Information from the MISR ATBD lists that consideration is being given to moving up the flying of SAGE III with the Russians providing the Platform.

Little is known about the Japanese and European sources although they potentially cover the period required. If this is a critical input and the sources in 2.03 do not cover the input, then consideration may have to be given to these non-US sources.

EOSP could be seen as a further backup.

D.04.3 Interface to Processing

The data are required as input to remove attenuation of stratospheric aerosols in generating the Level II AP. Depending on the aerosol product obtained and used in processing, substantial subsetting and gridding may be required to provide coverage for MSIR Level 2 processing.

D.04.4 Ingestion Route

Once SAGE III is available, access to its products should be possible since it is archived at LaRC DAAC. Exact ingestion route will depend on local configuration of hardware which is a matter for the DAAC. The timeliness of arrival depends mostly on the production rate of SAGE rather than the delivery mechanism (TBC). **Should non-US sources be used, the ingestion mechanism would become a major issue.**

D.04.5 Verification

TBD depending on source selected.

D.04.6. Group Responsible for Development

ECS are responsible for development of the tools and verification.

D.04.7 Temporal Availability and Source Security

As noted above, SAGE II will not be able to service TRMM or EOS-AM, ILAS and SCIAMACHY as a backups suffer from being processed in Japan/Europe. No details of POAM_AER are available.

The MISR Aerosol Climatology will suffice in most nominal cases of processing if not adequate source for Aerosol data can be found. It is important that a satellite source be available though in the event of a volcano dispersing aerosol particulates into the atmosphere.

D.04.8 Backup source

ILAS (Improved Limb Atmospheric Sounder) on ADEOS and the SCIAMACHY instrument are potential backup. SCIAMACHY is unlikely to yield operational products for some time after

launch (maybe 2 years); so unless ILAS can fill this gap, a problem remains. It is likely that the AVHRR product covering the column aerosol may well cover this requirement.

The MISR Team will also have developed a aerosol climatology that may include a layer dealing with stratospheric aerosols for part of their pre launch effort.

D.04.9. Schedule for Source, Ingestion Route and Associated Developments

Some tools to read HDF files will be available by spring '94. Development of process 12 will be to CERES AI&T schedule. Development of preparation function is TBD.

D.04.10 Testing

The need for this aerosol product during development and AI&T should be serviceable from the current SAGE II archive. This is available now from LaRC DAAC with products in native format. Ad-hoc reformatting or these products will probably be required although translation into HDF is anticipated.

D.05 Digital Elevation Model (DEM)

D.05.1 Introduction

In MISR standard processing, the global DEM will be used in the developing and updating of the MISR Level 1B2 Ancillary Geographic Product (AGP) and in developing the camera models for all nine of the MISR cameras. The MISR ST would like the EOS Project to support the Science Working Group of the AM Platform's (SWAMP) efforts to secure the release of DMA's DTED data for open distribution and use. If the release is not achieved, the ST will use a combination of DEMs to build the topographic data base that is needed for their AGP product. The SPSO External Option is N0002.

D.05.2. Source and Source Data Set Attributes

MISR requirements for a global DEM are met by the DEM requirements for the 250 and 500 meter bands of MODIS for radiometric correction (i.e., 100 meter horizontal and 30 vertical resolution). A detailed write-up on the status of global DEMs was given in the Appendix C (MODIS) and the reader is referenced to that section for more information on global DEMs including DTED data.

D.05.3 Interface to Processing

The MISR SDPT plans on using the global DEM data to produce their Level 1B2 product which will contain their AGP. Select layers of the Level 1B2 Product will be needed for processing all Level 2 products of MISR. More information is needed to understand how they plan on using the Level1B2 AGP in their standard processing.

D.05.4 Ingestion Route

The EOS Project is currently working the issue of a global DEM for all instruments of the AM-1 Platform. The ECS would use whatever DEM is supported by the EOS Project. It would reside at the various DAACs as an ancillary data set staged for processing.

D.05.5 Group Responsible for Development

The MISR ST has began development of their own global DEM for their Level 1B2 AGP Product. They have access to the Level 1 DTED data set at JPL and are using it to develop their own global DEM. They will still need a global DEM in ECS because the DTED coverage is not complete for all of the earth's surface. As soon as the global DEM is available from the ECS, they will complete their global DEM for their Level 1B2 Product.

D.05.6 Testing

Test data for the MISR group is not applicable given their plans to develop a global DEM from the DTED data they have access to at JPL. They do need the EOS Project to support the acquisition of or development of other global DEM

D.06 Ground Control Points (GCPs)

D.06.1 Introduction

The GCPs would be used to build and refine the Level 1B2 Product and enhance the camera model the MISR SDPT is developing. The SPSO external option is N0045.

D.06.2 Source and Source Data Set Attributes

In the ASTER Chapter, Section 7.06.2 contains detailed information concerning the source(s) for GCPs. The MISR ST is planning on using whatever GCPs the other AM Instrument Teams use. They will use the data in the development and refinement of their Level 1B2 AGP and need only a small set of GCPs to verify the accuracy of their Level 1B2 Product.

D.06.3 Interface to Processing

The GCPs would not be used in standard processing. The GCPs would be used at the SCF for MISR to develop and enhance their Level 1B2 Product.

D.06.4 Ingestion Route

The MISR ST envisions getting GCPs from the same source as other AM Instrument Teams (currently, the Landsat GCP at EDC DAAC). They will evaluate the Landsat GCP to determine its utility in their development work. If the Landsat GCP is not satisfactory, they may use their Landsat TM reference data to generate GCPs. Again, they plan on doing this effort at the SCF and no ingestion for standard product generation is needed.

D.06.5. Schedule for Developments

The development of the Level 1B2 Products have began at the team leader's SCF. More information is needed to determine how they are currently using GCPs in this development effort.

D.06.6 Testing

Testing is not applicable for this ancillary data set as the MISR group is developing their product at the SCF. The developed product will be used in standard processing at the DAAC and GCPs will not be needed for MISR standard processing at the DAAC.

D.07 Land/Sea Mask

D.07.1 Introduction

The Land/Sea Mask is needed for developing the Level 1B2 Product and the associated AGP. The SPSO external option is N0007.

D.07.2 Source and Source Data set Attributes

Several products are available such as DMA's Digital Chart of the World (DCW), World Vector Shoreline (WVS) and the CIA's World DataBase II (WDB II). Both are in digital format and available at low cost or freely available through anonymous ftp.

D.07.3 Interface to Processing

The Land/Sea Mask would not be used in standard processing. The GCPs would be used at the SCF for MISR to develop and enhance their Level 1B2 Product.

D.07.4 Ingestion Route

These data currently reside at several DAACs, (these data sets are already part of the Version 0 Pathfinder and IMS Efforts). No real ingestion is needed for EOS Time frame. The question whether the MISR Team has these data needs TBD. If they do not they can be told the ftp site where to obtain the CIA WDB II or from one of the DAACs they have these data sets.

D.07.5 Verification

All global data sets appear to have varying quality at different areas of the globe. The SEAWiFS Project is using the DMA WVS data set which was compiled from 1:250,000 scale map sheets for most areas of the world. In places where 1:250,000 maps were not available the map with the largest scale possible was obtained.

It is unknown if any effort will be made to produce the most accurate product available from all known source data by the EOS-AM Time frame. It also must be ascertained whether any of these data sets take into account the tidal effect for coast lines which may occur for select overpasses during the EOS-AM mission.

D.07.6 Temporal Availability and Source Security

The DCW product is included on the NGDC CD-ROM. This contents of this CD-ROM is being used by PGS Toolkit Development Group already and will be included as part of October, 1994 Toolkit Delivery. The CIA WDB II is freely available.

D.08.1 Critical Dependencies and Sources

The AGP product being developed by the MISR SPS developers is a critical product needed by many other Level 2 MISR products. Although an internal product to the MISR Team, the Team does need access to as many global/regional DEMs to successfully build this product. Hence, availability of one high resolution and quality DEM is a critical dependency for the MISR Team.

Currently the MISR ST is rethinking its requirements for other non-EOS and EOS products in developing their Level 2 standard products and the ST should be re-surveyed in the future when they have finished this effort.

D.08.2 Implications for PGS Toolkit Ancillary Data Handling Tools

The development of swath based MISR Level 2 products may have an impact on the ancillary data handling tools developed. More effort is needed to understand the tools they will need for pre-processing other EOS and non-EOS data that are not of in a swath format.

D.08.3 Implications for PGS Pre-Processing and ECS Interfaces

The Q/A of ancillary data sets used in standard processing needs to be defined. Even before, understanding the Q/A done by the producing entity may help reduce concern of data quality that has been voiced by various AM-1 Teams. If Q/A issue is resolved this may reduce operation efforts in the PGS and the amount of preprocessing required for the various ancillary data sets.

The stated requirement for GAP Products that have used scatterometer data in the development of wind parameters over the ocean surface may result in an interface with ECMWF. The scatterometer scheduled to fly on ADEOS I (SEAWINDS) may be a valid substitute to use in place of ECMWF GAP data.

D.08.4 Outstanding Issues

The availability of high resolution global DEM and of GAP wind product developed with scatterometer data are the two most critical issues for the MISR ST at this time. Redefining their standard processing needs to be monitored so that this appendix can be updated and enhanced as appropriate. Hence, this appendix needs to be considered a draft of their processing needs at best.

Appendix E MOPITT

E.01 Introduction

MOPITT processing will require a variety of external input data. All ancillary inputs will be to the MOPITT Level 2 generation algorithms. The required ancillary data include atmospheric temperature, humidity and aerosol profiles. Cloud property information, such as cloud masks and cloud heights will initially be required correlative inputs, but may very likely become required ancillary inputs.

Figure E-1 displays the necessary external data inputs to MOPITT Level 2 processing. This high level diagram of MOPITT processing was constructed on the basis of the SPSO tables, the MOPITT ATBD and conversations with MOPITT team members.

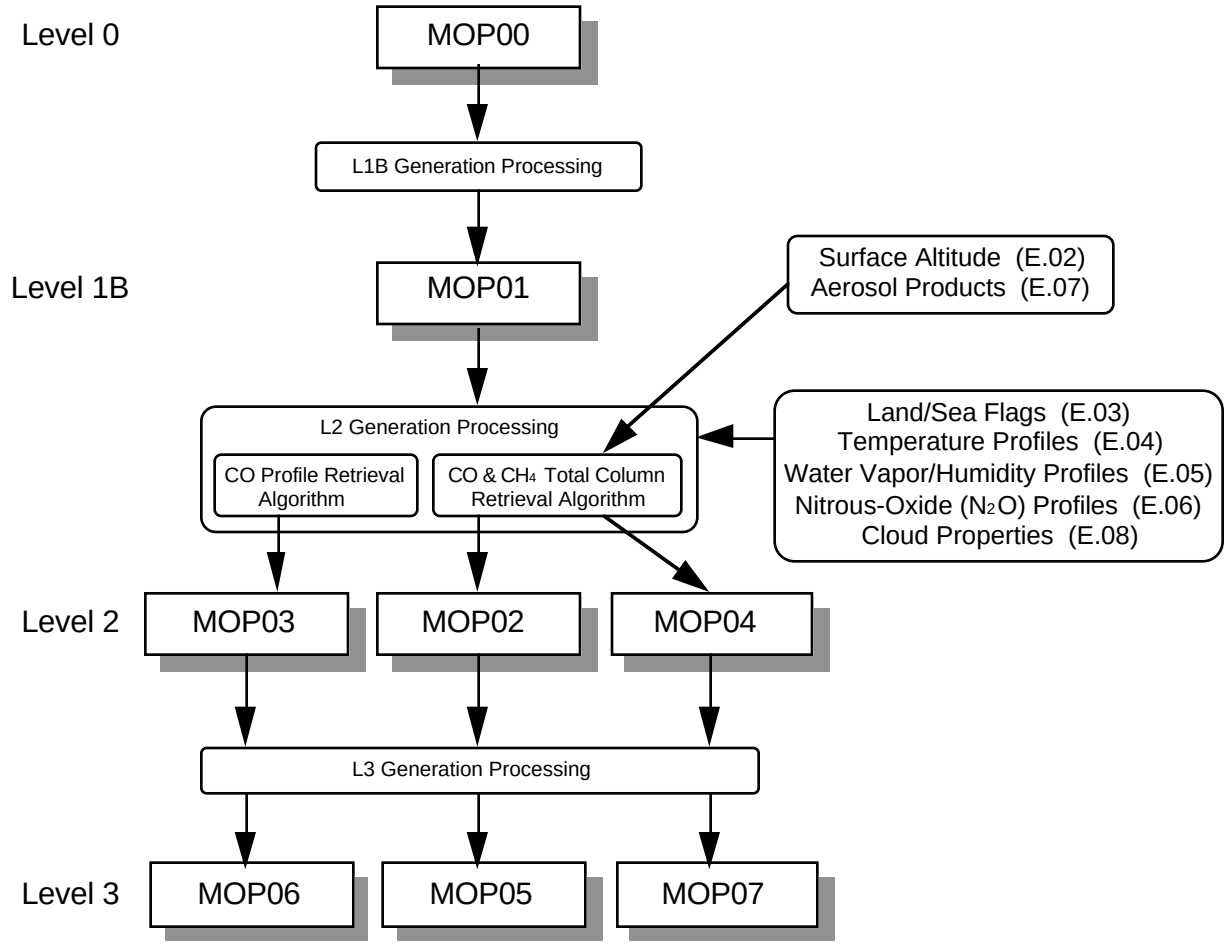


FIGURE E-1 External Inputs to MOPITT Processing

E.02 Surface Altitude

E.02.1 Introduction

Information on surface altitude will be required as Ancillary data in the generation of MOPITT Level 2 products. Specifically, the altitude of the surface observed by MOPITT is used in Level 2 processing to calculate the CO and CH_4 total column retrieval products MOP02 and MOP04.

This parameter does not currently appear as an SPSO external option. It is being added as a result of conversations with the MOPITT team and has been provisionally assigned as external option N0120.

E.02.2 Source and Source Data set Attributes

Input	**Terrainbase**
Parm #	---
Parm/ Product Name	Surface Altitude from DEM
Instrument	N/A
Platform	N/A
DAAC/ADC	ECS
from	?
to	?
GB/day	N/A
Units	?
Accuracy (Abs:Rel)	?
Temporal Res.	N/A
Horizontal Res:Cover	?
Vertical Res:Cover	?

The MOPITT team has indicated that their DEM requirements are for 10 km horizontal and 100 m vertical resolution. Currently, the only global DEM is the Terrainbase data set produced by NGDC. ECS is working to provide the Terrainbase DEM as a general use DEM for EOS investigators.

E.02.3 Interface to Processing

As an input to the MOP02 and MOP04 generation process, the preparation required for the DEM data set is expected to be a one time effort before launch.

E.02.4 Ingestion Route

ECS will provide the general use Terrainbase DEM to the MOPITT Level 2 processing string.

E.02.5 Group Responsible for Development

ECS is developing Terrainbase for use as a general DEM.

E.02.6 Testing

ECS development of the Terrainbase DEM as a general use DEM, as well as the tools to access it, will take place during the summer of 1994. The static Terrainbase data set and the tool(s) to access it should be available by Fall 1994.

E.03 Land/Sea Flag

E.03.1 Introduction

Land/Sea classification information will be required as Ancillary data in the generation of MOPITT Level 2 CO Profile products (MOP03) and CO and CH_4 Total Column products (MOP02 & MOP04). Land/Sea flags will be used to classify the surface type of individual data values from surface emissivity data sets (which may be either MOPITT team-supplied or derived from ECS-supplied temperature profile analyses (E.04)). This parameter does not currently appear as an SPSO external option. It is being added as a result of conversations with the MOPITT team and has been provisionally assigned as external option N0121.

E.03.2 Source and Source Data set Attributes

Input	**DCW_LND_SEA**
Parm #	---
Parm/ Product Name	Land/Water Flag from Digital Chart of the World
Instrument	N/A
Platform	N/A
DAAC/ADC	ECS
from	?
to	?
GB/day	N/A
Units	?
Accuracy (Abs:Rel)	1 - 3 km
Temporal Res.	N/A
Horizontal Res:Cover	1 : 1,000,000
Vertical Res:Cover	N/A

The source for this data is expected to be the ECS maintained data set derived from the Digital Chart of the World data set.

E.03.3 Interface to Processing

As an input to the MOP02, MOP03 and MOP04 generation process, the preparation required for this Land/Water data set is expected to be a one time effort before launch. It is anticipated that the PGS Toolkit routine PGS_AA_DCW will meet MOPITT's access needs for this data.

E.03.4 Ingestion Route

DCW surface classification products are expected to be provided by ECS.

E.03.5. Group Responsible for Development

If there are MOPITT-specific preprocessor requirements, they should developed by the MOPITT data processing team.

E.03.6 Testing

The development of the DCW, as well as the tools to access it, will take place during the summer of 1994. The static land classification data set and the tool(s) to access it should be available by Fall 1994.

E.04 Temperature Profiles

E.04.1 Introduction

Temperature profiles will be required as Ancillary data in generation of the MOPITT Level 2 products MOP02, MOP03 and MOP04. Temperature profiles previously appeared in the SPSO list under N0001, but only NMC was identified as a possible source; MISR was also identified with this external option number. In an attempt to avoid additional confusion, temperature profile input (from multiple sources) to MOPITT processing has been provisionally assigned as external option N0125/126.

E.04.2 Source and Source Data set Attributes

Input	COM.CED1.ANL .T0xx.AVN	ECMWF_MET	DAO_MET	MOD30
Parm #	---	---	---	3726
Parm/ Product Name	Temperature profiles	Temperature profiles	Temperature profiles	Temperature profiles
Instrument	N/A	N/A	N/A	MODIS
Platform	N/A	N/A	N/A	AM
DAAC/ADC	NWS	ECMWF	GSFC	GSFC
from	?	?	?	Jun-1998
to	?	?	?	Oct-2008
GB/day	?	?	?	11.2
Units	?	?	?	K
Accuracy (Abs:Rel)	?	?	?	0.5 K :: 1.5 K
Temporal Res.	6 hours	?	?	2/day
Horizontal Res:Cover	?	?	?	5 km, 0.5 deg :: global
Vertical Res:Cover	?	?	?	4 km :: Atmos. (20 levels)

The MOPITT team has indicated that temperature profiles are an essential ancillary input and that a 1x1 degree resolution is required. The file COM.CED1.ANL.T0xx.AVN is an example of an NMC analysis field product from the NMC aviation model, which is produced every 6 hours. It is not yet clear which of NMC products actually meets the requirement. The MOPITT team has identified NMC, ECMWF and DAO as potential primary sources. MODIS temperature profiles have also been identified as a potential source. Use of MODIS temperature products

could have a considerable PGS system impact. If MODIS is to serve as an effective backup source, any subsetting or reformatting needs to be performed at GSFC prior to transfer to LaRC.

E.04.3 Interface to Processing

Information on NMC products state that the current grid spacing is 2.5x2.5 degrees. Horizontal interpolation will be required in order to meet MOPITT's resolution requirement. This reformatting may be performed by a TBD ECS tool which will be designed to reformat and prepare data to a common access format.

E.04.4 Ingestion Route

The ingestion route for NMC data may be arranged by ECS such that all DAAC access to the data would be centralized at one location.

E.04.5 Verification

TBD

E.04.6. Group Responsible for Development

If the ECS supplied internal access format tools do not meet MOPITT's requirements, it remains to be seen other instruments have similar NMC data requirements. If such a case, the function of common preparation of the data should be assumed by ECS.

E.04.7 Temporal Availability and Source Security

It is expected that NMC will produce temperature profile products routinely and reliably.

E.04.8 Backup source

The MODIS temperature profile product is the preferred backup source.

E.04.9. Schedule for Source, Ingestion Route and Associated Developments

The tools for basic non-HDF read/write should be available by Spring '94

E.04.10 Testing

TBD

E.05 Water Vapor/Humidity Profiles

E.05.1 Introduction

Water vapor or humidity profiles will be required as Ancillary data in the MOPITT processing which generates the MOPITT Level 2 products MOP02, MOP03 and MOP04. Humidity profiles previously appeared in the SPSO list under N0001, but only NMC was identified as a possible source and MISR was also identified with this external option number. In an attempt to avoid additional confusion, humidity profile input (from multiple sources) to MOPITT processing has been provisionally assigned as external option N0126.

E.05.2 Source and Source Data set Attributes

Input	COM.CED1.ANL.T0xx.AVN	ECMWF_MET	ECMWF_RH	DAO_RH_PROD	DAO_MET	MOD30	MOD38
Parm #	---	---	---	---	---	3727	3725
Parm/ Product Name	Humidity profiles	Humidity profiles	Relative humidity	Relative Humidity	Humidity profiles	Water vapor profile	Water vapor, Atmospheric (Thermal IR)
Instrument	N/A	N/A	N/A	N/A	N/A	MODIS	MODIS
Platform	N/A	N/A	N/A	N/A	N/A	AM	AM
DAAC/ADC	NWS	ECMWF	ECMWF	GSFC	GSFC	GSFC	GSFC
from	?	?	?	?	?	Jun-1998	Jun-1998
to	?	?	?	?	?	Oct-2008	Oct-2008
GB/day	?	?	?	?	?	11.2	?
Units	?	?	?	?	?	?	?
Accuracy (Abs:Rel)	?	?	?	?	?	5 - 50% :: ?	>20% or 5mm :: ?
Temporal Res.	6 hours	?	?	?	?	2/day	?
Horizontal Res:Cover	?	?	?	?	?	5 km, 0.5 deg :: global	?
Vertical Res:Cover	?	?	?	?	?	4 km :: Atmos. (15 levels)	?

The MOPITT team has indicated that humidity profiles are an essential ancillary input and that a 1x1 degree resolution is required. The file COM.CED1.ANL.T0xx.AVN is an example of an NMC analysis field product from the NMC aviation model, which is produced every 6 hours. It

is not yet clear which of NMC products actually meets the requirement. The MOPITT team has identified NMC, ECMWF and DAO as potential primary sources. MODIS water vapor profiles have also been identified as a potential source. Use of MODIS water vapor products could have a considerable PGS system impact. If MODIS is to serve as an effective backup source, any subsetting or reformatting needs to be performed at GSFC prior to transfer to LaRC.

E.05.3 Interface to Processing

Information on NMC products state that the current grid spacing is 2.5x2.5 degrees. Horizontal interpolation will be required in order to meet MOPITT's resolution requirement. This reformatting may be performed by a TBD ECS tool which will be designed to reformat and prepare data to a common access format.

E.05.4 Ingestion Route

The ingestion route for NMC data may be arranged by ECS such that all DAAC access to the data would be centralized at one location.

E.05.5 Verification

TBD

E.05.6. Group Responsible for Development

If the ECS supplied internal access format tools do not meet MOPITT's requirements, it remains to be seen other instruments have similar NMC data requirements. If such a case, the function of common preparation of the data should be assumed by ECS.

E.05.7 Temporal Availability and Source Security

It is expected that NMC will produce humidity profile products routinely and reliably.

E.05.8 Backup source

The MODIS water vapor profile products are the preferred backup sources.

E.05.9. Schedule for Source, Ingestion Route and Associated Developments

The tools for basic non-HDF read/write should be available by Spring '94

E.05.10 Testing

TBD

E.06 Nitrous-Oxide (N_2O) Profiles

E.06.1 Introduction

Nitrous-Oxide (N_2O) profiles will be required as Ancillary data in the generation of the MOPITT Level 2 products MOP02, MOP03 and MOP04. During Level 2 generation, atmospheric transmittance for N_2O will be calculated by using climatological profile values as input. This parameter does not currently appear as an SPSO external option and is being added as the result of new information in the MOPITT ATBD. It has been provisionally assigned as external option N0122.

E.06.2 Source and Source Data set Attributes

Input	**N2O_PROFILE**
Parm #	----
Parm/ Product Name	Climatology, Nitrous-Oxide Profiles
Instrument	?
Platform	?
DAAC/ADC	?
from	?
to	?
GB/day	?
Units	?
Accuracy (Abs:Rel)	?
Temporal Res.	?
Horizontal Res:Cover	?
Vertical Res:Cover	?

Possible sources for this nitrous-oxide climatological data are NMC or DAO analyses or as data supplied by the MOPITT team itself.

E.06.3 Interface to Processing

As an input to the MOP02, MOP03 and MOP04 generation process, the preparation required for this climatological data sets is expected to be a one time effort before launch. It is anticipated that the PGS Toolkit routine PGS_AA_GEO will meet MOPITT's access needs for this data.

E.06.4 Ingestion Route

The ingest source is not currently known.

E.06.5. Group Responsible for Development

As any preprocessor function for this data would likely be MOPITT-specific, it should developed by the MOPITT data processing team.

E.06.6 Testing

TBD

E.07 Aerosol Products

E.07.1 Introduction

Information on aerosol products will be required as Ancillary data during reprocessing of the MOPITT Level 2 CO and CH_4 total column retrieval products MOP02 and MOP04. The aerosol data may include MISR, MODIS, NESDIS, EnviSat and ADEOS1 products. This parameter does not currently appear as an SPSO external option and is being added as the result of new information in the MOPITT ATBD. It has been provisionally assigned as external option N0124.

E.07.2 Source and Source Data set Attributes

Input	MIS08	MIS08	MIS08	MIS08	MOD04	MOD04
Parm #	2299A	2335A	2334A	1993A	2293	1022
Parm/ Product Name	Gridded Aerosol Optical Depth	Gridded Aerosol Phase Function, Effective	Gridded Aerosol single-scattering albedo, Effective	Gridded Aerosol size- distribution parameters, Effective	Aerosol optical depth, spectral	Aerosol size-distribution (radius-dispersion)
Instrument	MISR	MISR	MISR	MISR	MODIS	MODIS
Platform	AM	AM	AM	AM	AM	AM
DAAC/ADC	LaRC	LaRC	LaRC	LaRC	GSFC	GSFC
from	Jun-1998	Jun-1998	Jun-1998	Jun-1998	Jun-1998	Jun-1998
to	Oct-2008	Oct-2008	Oct-2008	Oct-2008	Oct-2008	Oct-2008
GB/day	?	?	?	?	0,001	0.0003
Units	?	?	?	?	?	?
Accuracy (Abs:Rel)	?	?	?	?	0.05 :: 0.02(Ocean); 0.1 :: 0.04(Land)	30-50% :: 30-50%
Temporal Res.	?	?	?	?	1/day	1/day
Horizontal Res:Cover	?	?	?	?	50x50 km (Land); 5x5 km (Ocean)	5x5 km :: Ocean
Vertical Res:Cover	Column :: Atmos.	N/A :: Trop.	N/A :: Trop.	Column :: Atmos.	N/A :: Atmos.	N/A :: Atmos.

Input	TKTG01	TKTG02	TKTG03	TKTG04	TKTG05	SCIA_ AER	ILAS_ AER
Parm #	---	---	---	---	---	---	---
Parm/ Product Name	Global Aerosol observations	Aerosol global analyzed fields	Aerosol daily summarized file	Aerosol extreme events observation file	Aerosol monthly mean field file	Aerosol	Aerosol
Instrument	AVHRR	AVHRR	AVHRR	AVHRR	AVHRR	SCIAMACHY	ILAS
Platform	POES	POES	POES	POES	POES	EnviSat	ADEOS1
DAAC/ADC	NESDIS	NESDIS	NESDIS	NESDIS	NESDIS	ESRIN	Japan
from	Jan-1990	Jan-1990	Jan-1990	Jan-1990	Jan-1990	Jan-1998	Jan-1996
to	Jan-2010	Jan-2010	Jan-2010	Jan-2010	Jan-2010	Jan-2001	Jan-1999
GB/day	0.00652	0.00021	0.000013	0.000704	0.000016	?	?
Units	Optical Depth Units	Optical Depth Units	Optical Depth Units	Optical Depth Units	Optical Depth Units	?	?
Accuracy (Abs:Rel)	0.03-0.05 ODU	0.03-0.05 ODU	0.03-0.05 ODU	0.03-0.05 ODU	0.03-0.05 ODU	?	?
Temporal Res.	6 hours	7 days	6 hours	6 hours	monthly	?	?
Horizontal Res:Cover	8 km :: orbital swaths	N/A :: global (70N - 70S)	N/A :: global	8 km :: global	N/A :: global (70N - 70S)	?	?
Vertical Res:Cover	N/A	N/A	N/A	N/A	N/A	?	?

The MOPITT ATBD did not list any sources for this aerosol information, but the tables above list the potential sources of MISR and MODIS instrument data, and AVHRR, SCIAMACHY and ILAS products.

E.07.3 Interface to Processing

Inputs of these aerosol products as Ancillary data to the MOP02, MOP03 and MOP04 generation process will require TBD preprocessing and/or regridding. This could be a considerable impact PGS system in the case of MODIS products. MODIS and MISR Level 2 products are assumed to be in HDF, and suitable PGS_IO_HDF tools should provide the ancillary tool access to the data.

E.07.4 Ingestion Route

MODIS Level 2 aerosol products will be transferred from the GSFC DAAC; it should be investigated whether subsetting of the Level 2 MODIS data should occur before the data is

transferred to the LaRC DAAC. MISR Level 2 aerosol products will be transferred internally at the LaRC DAAC to the MOPITT processing string. AVHRR products are assumed to be available in near real time electronically from NESDIS via the SAA. It is not currently known how the European (SCIAMACHY/EnviSat) and Japanese (ILAS/ADEOS1) data will be ingested by ECS.

E.07.5 Verification

TBD

E.07.6. Group Responsible for Development

TBD

E.07.7 Temporal Availability and Source Security

MODIS and MISR products should be available for MOPITT processing. AVHRR data from NESDIS is assumed to be available operationally.

E.07.8 Backup source

It is believed that the MODIS, MISR and the four-times daily AVHRR aerosol products are all potential primary sources, with the SCIAMACHY, ILAS and remaining AVHRR products serving as backup.

E.07.9. Schedule for Source, Ingestion Route and Associated Developments

The tools for basic non-HDF read/write should be available by Spring '94. The tools for basic HDF read/write should be available by Fall '94.

E.07.10 Testing

TBD

E.08 Cloud Properties

E.08.1 Introduction

Information on cloud properties will routinely be required as Correlative data during reprocessing of the MOPITT Level 2 products MOP02, MOP03 and MOP04. The necessary cloud properties will include cloud masks to be used in all Level 2 reprocessing and also cloud heights which would be of special use in reprocessing Level 2 CO Profile retrieval products (MOP03). These parameters do not currently appear as SPSO external options and are being added as a result of new information in the MOPITT ATBD. The Cloud Properties parameters have been provisionally assigned as external option N0123.

E.08.2 Source and Source Data set Attributes

Input	MOD06	MOD06	MOD06	MOD06	MOD06
Parm #	2081	1764	1780	2311	1528
Parm/ Product Name	Cloud Product; Cloud Cover	Cloud Product; Cloud Particle Phase	Cloud Product; Cloud Particle Size (Effective & Radius)	Cloud Product; Cloud Optical Depth	Cloud Product; Cloud Properties, Top
Instrument	MODIS	MODIS	MODIS	MODIS	MODIS
Platform	AM	AM	AM	AM	AM
DAAC/ADC	GSFC	GSFC	GSFC	GSFC	GSFC
from	Jun-1998	Jun-1998	Jun-1998	Jun-1998	Jun-1998
to	Oct-2008	Oct-2008	Oct-2008	Oct-2008	Oct-2008
GB/day	?	?	?	?	?
Units	%	Water/Ice	microns	dimension-less	mb
Accuracy (Abs:Rel)	5% :: 3%	90% Conf. :: 90% Conf.	20% :: 5%	10% :: 5%	50 mb :: 25 mb
Temporal Res.	2/day [d,n], 1/month	1/day	1/day	1/day [d]	2/day
Horizontal Res:Cover	5 km :: global	5 km :: global	5 km :: global	5 km :: global	0.5 deg :: global
Vertical Res:Cover	N/A :: Cloud	N/A :: Cloud	N/A :: Cloud	N/A :: Cloud	N/A :: Cloud

Input	TAGF01	TATG01	SSMT_NEPH	GOES_ASOS_CLD
Parm #	---	---	---	---
Parm/ Product Name	Convective cloud top height analysis	Cloud Amount & Cloud Top Pressure	Real-time Nephanalysis Cloud Amount/Type/ Height	ASOS Cloud Cover Supplement
Instrument	VISSR	HIRS/2	SSM/T	VAS
Platform	GOES	GOES	DMSP	GOES
DAAC/ADC	NESDIS	NESDIS	NESDIS	NESDIS
from	Jan-1990	Jan-1990	Feb-1989	Feb-1989
to	Jan-2010	Jan-2010	?	?
GB/day	?	?	?	?
Units	?	C	?	?
Accuracy (Abs:Rel)	(+/-) 5000 feet	~15%, 20-70 mb	?	Amount : (+/-) 1 category Height : ~5000 feet
Temporal Res.	6 hours	orbital	1 per day	hourly
Horizontal Res:Cover	8 km :: Hemispheric	50 km :: orbital	? :: global	Site Specific :: Continental US.
Vertical Res:Cover	1000 - 100 mb	N/A	4 layers	Above 10,000 feet

MOPITT has listed MODIS Level 2 products as the desired source of cloud mask and cloud top radiance values. The MOPITT ATBD also contains the requirement for cloud height information as input for the generation of Level 2 CO Profile retrieval products (MOP03). Although MOPITT listed no sources, the table above lists two NESDIS products (TAGF01, SSMT_NEPH) which may provide primary sources for cloud height data. The table above also provides potential sources from GOES and DMSP satellites for cloud amount and type data.

E.08.3 Interface to Processing

Inputs of these cloud properties as Ancillary data to the MOP02, MOP03 and MOP04 generation process will require TBD preprocessing and/or regridding. MODIS Level 2 products are assumed to be in HDF, and suitable PGS_IO_HDF tools should provide the ancillary tool access to the data.

E.08.4 Ingestion Route

MODIS Level 2 cloud property products will be transferred from the GSFC DAAC. GOES and DMSP products are assumed to be available in near real time electronically from NESDIS via the SAA.

E.08.5 Verification

TBD

E.08.6. Group Responsible for Development

As any preprocessor function for this data would be MOPITT-specific, it should developed by the MOPITT data processing team.

E.08.7 Temporal Availability and Source Security

MODIS products should be available for MOPITT processing. Cloud height data from NESDIS is assumed to be available operationally.

E.08.8 Backup source

Cloud cover amount and type information from GOES and DMSP satellites may provide adequate backup sources. The MOPITT team has also expressed an interest in receiving any DAO cloud mask product that might be developed in the future that uses as input other EOS-AM instruments such as MODI, CERES and MISR.

E.08.9. Schedule for Source, Ingestion Route and Associated Developments

The tools for basic non-HDF read/write should be available by Spring '94. The tools for basic HDF read/write should be available by Fall '94.

E.08.10 Testing

TBD

E.09 Conclusions

A number of MOPITT processing inputs have been identified here which do not appear in the SPSO lists but have been added as a result of new information in the MOPITT ATBD and conversations with MOPITT team members.

A crucial item is that more information is needed on the format and resolution required for MODIS temperature, humidity, aerosol and cloud products, as they have a enormous potential impact on PGS throughput. Aside from the potential system difficulties in providing MODIS products as routine ancillary inputs, it appears that nearly all of MOPITT's ancillary needs can be met by static data sets and NMC or DAO analyses.

Further discussion is necessary with the MOPITT team regarding their format requirements for input data to their processing algorithms, as well as what PGS tool interfaces are forseen.

Appendix F ASTER

Introduction

The ASTER processing scheme is different than the other instruments on the AM-1 Platform in that the Level 0 to Level 1B processing is done in Japan. Also, almost all of the processing of higher level products is done in a "processing on demand mode", versus routine processing which is planned for the other instruments on AM-1. The Level 2 and higher level products are currently slated to be generated and archived at the EDC DAAC. Many of the same ancillary data sets as needed by MODIS are required for the Joint ASTER Science Team (ST) to develop their products. Hence, several references back to the MODIS Appendix C are made throughout the course of the appendix.

F.01 Gridded Analysis Product (GAP)

F.01.1 Introduction

Gridded Analysis Data such as NOAA National Meteorological Center (NMC) are required by the standard product software being developed by ASTER ST members to produce surface radiance products that have been corrected for atmospheric effects. The GAP surface quantities such as surface temperature are also required for the ASTER Polar Cloud Work. The SPSO external option is N0009.

The GAP parameters needed are the following:

1. surface pressure;
2. temperature and water vapor profiles, (including surface levels);
3. relative humidity; and
4. surface winds over the ocean.

F.01.2 Source and Source Data set Attributes

NMC characteristics need further defining as far as gridding and formatting information

F.01.3 Interface to Processing

The GAP data will be used in the Level 2 processing step to implement atmospheric correction work on the ASTER Level 1A/B data. The specific ASTER Products that will need these data are the surface radiance products (AST09, parameters 2378 and 3817). At the moment, it appears the PGS Toolkit will need to support members of the ASTER ST with similar preprocessing tools (e.g., regridding and interpolating tools).

F.01.4 Ingestion Route

Ingestion of NMC for ASTER Processing will not be any different from what is being done for MODIS, hence the summary given in Appendix D, Section D.01.4, would apply to ASTER Processing.

F.01.5 Verification

More information is needed in understanding how quality assurance (Q/A) of ancillary data such as NOAA NMC is done in an operational environment. This information is needed by the ECS PGS Group to help them understand the level of Q/A of the data that the ECS will be ingesting for standard processing. The ASTER ST members would also like clarification concerning the ECS plans on the Q/A of NMC Analysis Data. Information on NOAA's Q/A policies is now being sought. The level of Q/A the PGS is proposing to do should be forthcoming during the System Design Review (SDR) for ECS being held in late June, 1994.

F.01.6 Group Responsible for Development

An issue that ASTER ST would like resolved is to what extent the PGS Toolkit will support the preprocessing (i.e., regridding, subsetting and interpolating) of NMC data. PGS Toolkit personnel are planning to provide more functionality as far as ancillary data handling in the next PGS Toolkit delivery. Members of the Toolkit Group are in the design phase of ancillary data handling (ADH) tools and more information should be available during late summer 1994.

F.01.7 Temporal Availability and Source Security

NMC data is routinely produced because of its importance to global weather forecasting efforts. These data should be available on a regular basis. Again the discussion presented in Appendix D, Section D.01.7 is applicable to ASTER processing.

F.01.8 Backup Source(s)

One potential backup source is ECMWF GAP. The products are similar (more information needed), but there is a cost implication of ingesting these data. ESDIS Project guidance is needed if this backup source is required.

The EOS GEOS Assimilation Product is also a possible backup source once that product becomes operational. The acceptance of this product by the ASTER ST is TBD. The early GEOS model is being produced daily by the DAO at GSFC. Its use in prototype code could provide value information on the utility of the GEOS models for atmospheric parameters required for standard processing in the EOS AM-1 era.

Fleet Numerical Operations Center (FNOC) also produces an analysis product which is archived at NCDC. Availability of this product within 24 hours needs further clarification. These data have been used by certain MODIS ST members for processing heritage remotely sensed data (e.g., CZCS). Whether these data satisfy the other AM Instrument Teams is TBD.

NSCAT and the advanced NSCAT follow-on (SEAWINDS) are part of the planned payload of the ADEOS I and II Platforms. These sensors should provide global wind fields products over the oceans for doing atmospheric correction work.

Instruments scheduled to fly on EOS PM-1, for example, the AIRS/AMSU Sensors are also capable of producing atmospheric temperature and humidity profiles and surface pressure data.

The Table found in Section A.07 of Appendix A (CERES) of this Discussion Paper provides more information about each of the potential backup sources listed above and other potential sources.

The ASTER ST is very interested in using MODIS Water Vapor and Temperature Profile Products in place of NMC Analysis Data once these MODIS products become operational.

F.01.9 Schedule for Source, Ingestion Route and Associated Developments

The preprocessing of the gridded analysis data could be a significant development, especially if common development covering several instruments is undertaken. An early decision on the preprocessing functionality the PGS Toolkit will support and the ingestion route for the Toolkit efforts should be made.

F.01.10 Testing

Obtaining selected data sets of GAP should be done for prototyping efforts. Using the ftp mechanism that DAO and the SEAWiFS Project use to obtain GAP should be investigated.

F.02 Total Column Ozone

F.02.1. Introduction

The total column ozone data is used in Level 2 processing to perform atmospheric corrections to the ASTER Level 1A/B Data in generating surface radiances. The SPSO external option is N0005.

F.02.2 Source and Source Data Set(s) Attributes

Table F.02.2-1 list several sources of ozone product data in the EOS-AM1 time frame. To date, processed data from the Total Ozone Mapping Sensor (TOMS) has been cited as one possible source by the ASTER ST.

Since 1983, the TOMS data collected on NIMBUS 7 have been processed to produce a gridded Level 3 product, GRIDTOMS, which is a measure of the total columnar ozone. Daily global coverage was obtained by the TOMS on NIMBUS 7 allowing the processing to create a daily global product. This work has been done by the TOMS Ozone Processing Team (OPT) which is part of the Lab of Atmosphere (Code 916) at GSFC. They have processed all of the NIMBUS 7 TOMS data collected and have archived all useful GRIDTOMS products at NSSDC (which is now being incorporated as part of the GSFC DAAC). These data are available on 9 track tape(s) or two CD-ROMs from NSSDC. The OPT has also set up an anonymous ftp to distribute NIMBUS 7 TOMS products and will distribute the data on user supplied storage media.

When developing the GRIDTOMS Product, the OPT decided to generate a daily product that had the following product attributes:

1. A gridded product that contains column ozone values and reflectivity averages;
2. A global product that used an equal area map projection; and
3. A product that preserves the TOMS sensor pixel resolution as much as possible.

A series of TOMSs are scheduled to be flown within the next five years. In June 1994, a TOMS will be the payload on one of the Earth Probe Satellite Series being launched. A TOMS is also slated to be part of the payload on ADEOS I and ADEOS II, which will be launched in 1996 and 1999 respectively. Thus, if these satellites are deployed successfully, and the instruments operate nominally, TOMS data should be available through the year 2003.

Table F.02.2-1 Potential Sources of Ozone Data for Standard Processing

Input Product	GRIDTOMS	TITG03	O3 Total Burden	O3 Total Burden
SPSO Prod/Parm #s	N0005/552	N/A	MOD07/1333	AIR08/1332
Sensor Data	TOMS	SBUV/2	MODIS-AM1	AIRS-PM1
Sensor Platform	Nimbus 7,	POES	EOS-AM1	EOS-PM1
DAAC/ADC	GSFC DAAC	NOAA/NESDIS	GSFC	GSFC
Available from	1978	1990	1998	2001
To	2005	N/A	2003	2005
Daily Product Volume	0.4 MBytes/day	N/A	0.4 Gbytes/day	0.004Gbytes/day
Units	Dobson Units	Dobson Units	Dobson Units	Dobson Units
Accuracy Reported	+/- 1.3 % uncertainty	+/- 1%	+/- 30 DUs(abs.)	+/- 15 % (abs.)
Temporal Resolution	Global/Daily	Global/Daily	Reg./Daily Global/weekly	Reg/Daily; Global/Weekly
Horizontal Resolution	1 x 1.25 dg grid	200 x 200 km	5 km daily .5 x .5 degree/weekly	50 km x 50 km
Vertical Resolution (if applicable)	no atmos. levels -column values	Both total col. and vertical levels are avail.	no atmos. levels - column values	no atmos. levels-column values

Note: The notation "**N/A**", is used to mean the information needed was ***not available***, and the notation "**n/a**" was used to mean that it was ***not applicable*** to that particular cell of the table.

F.02.3 Interface to Processing

The ozone data will be used for doing atmospheric corrections of Level 1A/B to produced accurate surface radiances. The ozone data will have to undergo the same preprocessing as the GAP data in order to use these data in processing, hence the same PGS Toolkit tools are required (i.e., regridding, subsetting and interpolating when needed).

F.02.4 Ingestion Route

In the EOS era, TOMS data sets should be readily available via the GSFC DAAC. The OPT have an agreement with the GSFC DAAC to distribute their Level 3 gridded product to the DAAC on a daily basis in HDF format. They will also maintain an anonymous ftp site where users can get the data if they desire. Communication Lines between the GSFC and EDC DAACs will need to be reliable to insure timely deliveries.

F.02.5 Verification

For the OPT ozone product, the daily global maps are produced in hard copy form and distributed to the scientists who developed the algorithms to generate the ozone products. If anomalies are noted, the appropriate scientist(s) are notified and anomaly detection begins. In most instances anomalies detected can be corrected for the best possible correction within one week. The data are then reprocessed if the reprocessing will improve the daily products with the anomaly. If no correction can be done (e.g., chopper wheel filter of the sensor is working improperly), then the products are produced with the anomaly included.

F.02.6 Group Responsible for Development

The OPT plans on processing new TOMS data for both the upcoming Earth Probe and the ADEOS missions. Conversion of the GRIDTOMS product into HDF should help with ingesting the ozone data into the processing.

F.02.7 Temporal Availability and Source Security

The OPT usually run one to two days behind in producing a level 3 product. For example, data collected onboard for one day are usually available within 24 hours after the OPT has received that data from the ground receiving station (Wallops Island). In discussions with members of the OPT they have stated that the TOMS products are available on a daily basis 95 percent of the time. If they have problems with data transmission from the satellite to Wallops they will post a product that does not have global coverage. Once all of the data for a given day are received they will reprocess the data to produce a product with as much global coverage as possible. Even when there are problems in obtaining the data from the satellite, the OPT usually produce a product within two days after the data have been collected.

As is listed above, the OPT does make the data available via ftp or user supplied media. Also, an agreement between the OPT and the GSFC DAAC has been made so that the ozone products will be delivered to the DAAC on a daily basis.

F.02.8 Backup source(s)

In the EOS-AM1 time frame, the ASTER ST plans on using the MODIS Ozone Product (MOD07) once it becomes an operational product. Once EOS-PM1 is launched and the AIRS Instrument is operating nominally, then another source of ozone data will be available. The AIRS ST will produce both a column ozone product and a product with ozone concentrations at four levels of the atmosphere (AIR08).

NOAA/NESDIS also produces a daily global product using the SBUV/2 sensor on the POES Platform. NESDIS uses the same algorithms as OPT, but their SPS is slightly different. They create a product with ozone concentrations at different levels of the atmosphere. The ASTER ST has initially concluded that having an ozone product that has information at different atmospheric layers would not add that much accuracy to their surface radiance products. The known characteristics of all three of these products are listed above in Table F.02.2-1.

The processing of SAGE-II data also creates a global ozone product that may also be suitable for standard processing. More information concerning that product's characteristics can be found in Section B.05 of the this report. The SAGE data products will be one of the products supported by Version 0 Activities of the LARC DAAC.

F.02.9. Schedule for Source, Ingestion Route and Associated Developments

The preprocessing tools required for handling the GRIDTOMS data are similar to the requirements for preprocessing GAP data, (e.g., regridding and interpolating). See section F.01.9 for more information.

F.02.10 Testing

Currently, two CD-ROMs are available from NSSDC that contain TOMS Ozone data for approximately 13 years. Ozone data are also available via anonymous ftp. These data sources are adequate for test data.

F.03 MISR Aerosol Products

F.03.1 Introduction

Selected parameters of the MISR Level 2 Aerosol Product (MIS05) are required in generating the surface radiances from ASTER Level 1A/B data. The specific ASTER Products that will need these data are the surface radiance products (AST09, parameters 2378 and 3817).

The ASTER ST also requires a stratospheric aerosol product especially to do atmospheric corrections of ASTER data after a volcano has erupted and it is dispersing particulate into the atmosphere. Information about the stratospheric aerosol products from sensors such as SAGE are described in Section B.04 of this report. More information concerning the use of the stratospheric aerosol product in the ASTER Processing will be included in an update of this report.

F.03.2 Source and Source Data Attributes

The MISR Level 2 Aerosol Product is slated to be produced at the LARC DAAC on a daily basis for regions of the globe. This product will be generated at 275 meters (m) for regional areas and 1.1 km for the globe. Parameters for this product are listed in Table F.03.2-1 below.

Table F.03.2-1 Characteristics of MISR, MODIS and AVHRR Aerosol Products

Input Product	MISR Aerosol Products	MODIS Aerosol Products	TKTG01
SPSO Prod/Parm #s	MIS03 / 2299	MOD04	n/a
Sensor Data	MISR	MODIS	AVHRR LAC and GAC Data
Sensor Platform	EOS-AM1	EOS-AM1	POES
DAAC/ADC	LARC DAAC	GSFC DAAC	NOAA/NESDIS
Available from	July, 1998	July, 1998	January, 1990
To	July, 2003	July, 2003	January, 2010
Daily Prod. Vol.	No Estimate Available	3.54 Gbytes/day	0.706 Gbytes/day
Units	dimensionlness	dimensionlness	optical depth units (Douse)
Accuracy Reported	0.05 for tau < 0.5 and 0.10 for tau > 0.5	0.05 for areas over the ocean, and 0.10 for areas over land	0.03-0.05 ODUs
Temporal Res.	Daily / 9 day Global	orbit swaths daily, n/a for global products	weekly
Horizontal Res.	17.6 km - Land 2.2 km -Ocean	50 x 50 km for land, 5 x 5 km for ocean areas	1 x 1 Degree Global product (only 70 N/S)
Vertical Res (if applicable)	n/a	n/a	n/a

Note: n/a - not applicable (source: for MISR Level 1B2 ATBD and SPSO Database February, 1994; for AVHRR Product, NOAA/NESDIS Operation Product Tables Dated February 15, 1993)

F.03.3 Interface to Processing

The MISR Aerosol Product is being used to remove the atmospheric attenuation of the ASTER surface radiances. Preparation of MISR data in this processing may need substantial preprocessing software given that MISR Level 2 data are in swath format and obtaining the MISR Level 1B2 Ancillary Geographic Product (AGP) would be required.

Timing of Japanese processing of Level 0 data into Level 1A data does factor into the preprocessing needed. If the timing is such that the MISR Product has gone from a Level 2 to a global Level 3 product, preprocessing effort may be less due to the gridded nature of the MISR Product. Also a factor is that most ASTER standard products are generated based on a request for the data (i.e., processing on demand scenario). Again, a user could order processing of an ASTER scene for which MISR or MODIS data in a Level 3 form exists. Inter-EOS Instrument processing will need to be investigated further as the standard products for EOS AM-1 become more defined.

F.03.4 Ingestion Route

MISR data products are scheduled for production at LARC DAAC, MODIS products at GSFC DAAC. Transfer to EDC DAAC adds to load on inter-DAAC communications. Communication requirements, as far as the volume and frequency of data transfers between DAACs is under study at this time. More information about these requirements should be available during the upcoming SDR.

F.03.5 Verification

MISR and MODIS Science Team would be responsible for their respective product Q/A and generating the appropriate flags concerning the Q/A of their data products.

F.03.6 Group Responsible for Development

The preparation of the MISR product data could be a significant development for ASTER SPS. The MISR Group has put forth the first version of their products format in developing their ATBDs. It appears ASTER ST would be responsible for the development of SPS to ingest and process the MISR product in their processing software. Depending on the capabilities (i.e., regridding, subsetting and interpolating tools) of the PGS Toolkit tools for preprocessing ancillary data, ASTER ST could use these tools as part of this SPS. In talking with the MISR Science Data Processing Team, it appears that a user of a Level 2 MISR product would also need to obtain the MISR Level 1B Ancillary Geographic Product to geolocate the Level 2 Aerosol Product, processing implications (if any) need to be understood.

F.03.7 Temporal Availability and Source Security

MISR and MODIS products should be available for ASTER processing. The fact that there are two similar inputs available within the ECS should mean that the input is secure. ASTER ST does have the fall back position of using their aerosol climatology if both AM-1 instrument products are not available for any reason.

F.03.8 Backup source

The ASTER ST has cited the MODIS aerosol product as the secondary backup source for aerosol input and their own aerosol climatology as a source to use if MISR and MODIS Product Data are not available. The AVHRR Aerosol Products are also available, preference on their use as a backup source needs TBD.

F.03.9 Schedule for Source, Ingestion Route and Associated Developments

The capabilities of the ancillary data handling tools of the PGS Toolkit will help determine the amount of effort required in developing ingestion and preparation tools for ASTER SPS.

Another issue that need resolution for the ASTER PGS team (and for all EOS AM-1 Instruments), is the interface information between the AM-1 instrument teams that want to use each others products. The ASTER PGS team has concluded they need the interfaces for MODIS and MISR instrument products defined by the latter part of 1995 in order to meet their SPS deliveries to the DAACs.

F.03.10 Testing

The AVHRR operational products listed in Table F.03.3-1 or the Aerosol Climatology Database being developed by the Joint ASTER Science Team could be used for prototype efforts.

F.04 Snow and Ice Cover

F.04.1 Introduction

The National Ice Center's (NIC) weekly Sea Ice Product is needed for the ASTER Polar Cloud Mask Product and may also be used for Scene Classification Mask. Clarification of the SPSO external option number is needed. It may be met by N0056.

F.04.2 Source and Source Data set Attributes

The NIC produces a routine product on a weekly basis using various satellite sources. Coverage of ice concentrations and thickness are the only products produced. This group does not generate a temperature or emmissivity product. Main output is hard copy image, but ice edge is digitized for NOAA to use in their NMC model efforts.

The ice product from NIC is produced from the analysis of SSM/I data, Optical Line Scanner (OLS), and AVHRR data. The weekly product varies in spatial resolution for each of the earth's polar regions and there is a slight variation in coverage for each region. The smallest resolvable ice areas are usually 20 x 20 km when the analysis system is running nominally and 40 x 40 km if the data for the week are not optimal. The reasons for less than nominal products varies, but can be caused by persistent cloud cover or missing data.

F.04.3 Interface to Processing

This product is needed for generating the Level 2 product, the Polar Cloud Mask. ASTER ST members generating this ASTER product should have software tools developed to ingest, interpolate and use these data to develop their product. These investigators have developed their product generating software for other efforts such as ISCCP cloud detection work. The ASTER Science Data Processing Team (SDPT) will integrate this investigation team's code as part of the ASTER processing software they plan on delivery to the EDC DAAC

F.04.4 Ingestion Route

Currently, the NSIDC DAAC is working on becoming the single distribution site for EOSDIS users of this product, (an agreement with NIC is in the final stages). NIC digital products are currently not converted into a digital form in real time with the exception of the NOAA work listed above. Further investigation is needed to determine whether NSIDC DAAC can support the conversion of the data from hard copy to digital form in a timely manner.

F.04.5 Verification

Information on the amount of verification of the NIC product is TBD.

F.04.6 Group Responsible for Development

This investigator team will have their own suite of software to preprocess these data (e.g., regrid and interpolate). How this group uses these data in their processing efforts now needs TBD. Section F.04.3 summarizes how their software will be integrated into the ASTER SPS.

F.04.7 Temporal Availability and Source Security

The hard copy product is produced reliably on a weekly basis. The question for standard processing is the timeliness in getting the weekly charts produced into a digital form. Amount of effort NSIDC is doing needs TBD.

F.04.8 Backup source

Appropriate backup sources are not obvious. Other satellite data such as SSM/I could supply the information although SSM/I is already an input to NIC. Higher quality products are probably available, but not in a near-real-time mode. The table in Appendix A (Table A.11.8) does list products from other EOS sensors such as MODIS and MIMR. Timeliness of regional products (for areas like Antarctica and the Arctic), from these sensors needs to be investigated to ascertain their utility in standard processing.

F.04.9 Schedule for Source, Ingestion Route and Associated Developments

See Sections F.04.3, F.04.6 and F.04.7.

F.04.10 Testing

These data are available currently for testing, no problem is foreseen in using what may become the operational source for test purposes.

F.05 Digital Elevation Model (DEM)

F.05.1 Introduction

For ASTER Level 2 processing, a global DEM would be used in the following processes:

1. The atmospheric correction processing;
2. The parallax correction of the short wave infrared (SWIR) ASTER bands;
3. The geo-referencing of ASTER data collected from different telescopes; and
4. In generating the Scene Classification Standard Product of ASTER.

The report entitled, "Topographic Data Requirements for EOS Global Change Research", developed by Dean Gesch of the EROS Data Center (1993) provides an excellent summary of the ASTER DEM requirements. Table F.05.01-1 from this summary is included to shows the type of horizontal and vertical requirements of the global DEM that the ASTER ST has concluded they need to develop their standard products. The SPSO External Option is N0002.

Table F.05.01-1 Elevation (in meters) which will Cause a One-Pixel Displacement in ASTER Data, and the Percentage of the Earth's Surface Higher than the Specified Elevation

Sensor SubSystem	Pixel Size (in meters)	Look Angle		
		+/- 2.4 degrees	+/- 10.9 degrees	+/-25.9 degrees
VNIR	15	323 / 68%	73 / 94%	35 / 79 %
SWIR	30	646 / 50%	146 / 85 %	not applicable
Therm. IR (TIR)	90	1938 / 26%	437 / 61%	not applicable

(source: Gesch, D. 1993. "Topographic Data Requirements For EOS Global Change Research")

F.05.2 Source and Source Data Set Attributes

ASTER requirements for a global DEM are probably fulfilled if the DMA's Level 1 DTED Data are released for use by the EOS Project. Currently, Level 1 DTED data do not exist for all land areas of the globe (approximately 75%). The use of the DCW DEM Product being generated at EDC DAAC will be used if no other high resolution DEM is available. For more information on both the DTED and DCW DEM data products the reader is referred to Appendix C of this report, where both have been summarized.

F.05.3 Interface to Processing

The DEM is needed for the processing listed in Section F.05.1 and the ASTER ST plans on using the PGS Toolkit ancillary data handling tools if their needs are met by this suite of tools. The type of tool functionality required would be searching a spatial database, subsetting of a gridded set and interpolating values to the subsetted area desired.

F.05.4 Ingestion Route

The EOS Project is currently working the issue of a global DEM for the AM-1 Platform. ECS will support whatever DEM is supported by the EOS Project. It would reside at the various DAACs as an ancillary data set staged for processing.

F.05.5 Group Responsible for Development

ECS PGS Toolkit tools will have access to at least one general purpose global DEM. ASTER ST needs access to whatever global DEM is available and in Section F.05.3 the tools needed for manipulating and using these data are listed. ASTER PGS group will evaluate the PGS Toolkit's ancillary data handling tools to determine if their needs are met. More information will be forth coming once the release of the PGS Toolkit occurs in the Fall 1994. If the PGS ADH Tools do not meet their needs they will develop their own tools.

F.05.6 Testing

Including the NGDC Terrain base data with the Fall, 1994 PGS Toolkit delivery should aid the SPS development team of ASTER to develop prototype software on accessing and using the global DEM. This would allow the developers to provide feedback on the suite of geolocation tools provided.

F.06 Ground Control Points (GCPs)

F.06.1 Introduction

The GCPs would be used to perform geo-referencing of ASTER Level 1A data. The SPSO external option is N0045.

F.06.2 Source and Source Data Set Attributes

Besides the GAP products for atmospheric corrections, the GCPs are the most important ancillary data set needed by the ASTER ST. Two known data sets that may partially fulfill this ancillary data set requirement are the GCP Library used for Landsat Processing at the EDC DAAC, and the WMED of the DMA. A description of the WMED has been listed in Appendix C (MODIS) of this report. The condition of the GCP Library is currently being assessed by EDC DAAC Staff. An initial White Paper on the GCP Library was released at the US. ASTER Science Team Meeting in mid-April, and a more thorough analysis of this Library is underway at EDC. A more detailed paper will be released in the late May, early June, 1994 time frame.

The ASTER Team is also waiting for the final resolution of the release of DTED, WMED and other DMA data sets that may be useful in geo-referencing ASTER data. At the AM-1 Science Working Group Meeting held in mid-May no resolution of this situation was known by the participants of the meeting.

The DMA's Digital Chart of the World (DCW) or the World Vector Shoreline (WVS) Data Sets may partially fill this need. Currently these data sets are available through federal government agencies such as NOAA NGDC or USGS and from private vendors. Both data sets have worldwide coverage and the accuracy of both data sets varies with location and with the data source used in compiling each product.

After the launch and operation of ASTER (i.e., launch + 1 year), the ASTER ST will also have access to ASTER DEMs which should be of high resolution. These DEMs will not be widespread in geographical coverage, but they should exist for study areas different ST members are looking at for a substantial period of time.

F.06.3 Interface to Processing

The processing of ASTER Level 1B data needs to be resolved. This is one of the major topics for the agenda of the Joint Science Team Meeting being held in late May 1994. In regards, to the PGS Toolkit development, it seems that the Toolkit will be of minimum use for the geo-referencing of the ASTER data. Current plans call for the EDC DAAC to have portions of their heritage software used as part of the geo-referencing software used to process ASTER data (e.g., GCTP software routines). Resolution of this processing issue will need to be monitored by the ECS PGS Group.

F.06.4 Ingestion Route

TBD as the Level 1B Processing Scenario is finalized.

F.06.5 Schedule for Developments

TBD as the Level 1B Processing Scenario is finalized.

F.05.6 Testing

TBD as the Level 1B Processing Scenario is finalized.

F.07 Land Surface Cover Product

F.07.1 Introduction

The Land Surface Cover product is needed for developing the ASTER Polar Cloud Mask. The SPSO external option is N0006.

F.07.2 Source and Source Data set Attributes

One source that is known to exist is the ecosystem database included on NGDC's Terrain Database CD-ROM. This data set is a global data set compiled from the EPA's Global Ecosystem data. NGDC has digitized this data set to include with their Terrain Ecosystem CD-ROM Package. The data set has been placed on a 10 x 10 minute latitude/longitude grid with the land areas of the globe classified into 59 ecosystems.

Another product being generated is the International Satellite Land Surface Climatology Project (ISLSCP) effort to develop a global land cover with a spatial resolution of 1 km x 1 km. This project is using the joint International Geosphere-Biosphere Program - NASA Pathfinder 1 km AVHRR data set that EDC DAAC is developing as the base data layer for their classification. The ISLSCP Project is just getting started and it should be completed by late, 1996.

F.07.3 Interface to Processing

This data set will be used to help discern clouds versus surface areas. The discussion given in Section F.04.3 also applies to these data.

F.07.4 Ingestion Route

The Land Cover Baseline data set should be at the EDC DAAC where the ASTER Level 2 Products will be generated on demand. No ingestion route is needed for this data set.

F.07.5 Verification

The ISLSCP Land Cover Product will be assessed for accuracy and a report concerning the accuracy and other characteristics of it will be published.

F.07.6 Group Responsible for Development

The ISLSCP is currently being done outside the scope of EOSDIS Activities. If it is completed by the 1996-1997 time frame EOSDIS can benefit from its use.

F.07.7 Temporal Availability and Source Security

If for whatever reason the ISLSCP Land Cover Effort does not take place, other data do exist but not at the resolution of 1 km x 1 km. The ASTER ST members developing the Polar Cloud Mask have already listed the NGDC Ecosystem Data as a source for this land cover information. This data set is available now and has been obtained by ECS PGS Group. It may be part of the October 1994 Toolkit release.

F.07.8 Backup source

Depending on progress of several efforts such as the ISLSCP 1 Km AVHRR Project should be completed prior to the launch of AM-1. Global NDVI data sets produced at NOAA/NESDIS is routinely produced but the quantification of these data sets to surface cover type is an extensive effort.

A 1 by 1 degree cover map has been produced by NASA researchers (Matthews, 1983) but this may not be of high enough spatial resolution for this ASTER Group.

F.07.9 Schedule for Source, Ingestion Route and Associated Developments

Distributing the NGDC Ecosystem Data with the October 1994 PGS Toolkit delivery may be advantageous to help SPS developers understand how to interface and interpolate with this data set.

F.07.10 Testing

The appropriate set for testing will depend on the choice of operational data sets. Different DAACs such as GSFC or EDC should have archived material available.

F.08 Land/Sea Mask

F.08.1 Introduction

The Land/Sea Mask is needed for generating the ASTER Polar Cloud Mask. The SPSO external option is N0007.

F.08.2 Source and Source Data set Attributes

Several products are available such as DMA's Digital Chart of the World (DCW) and the CIA's World DataBase II (WDB II). Both are in digital format and available at low cost or freely available through anonymous ftp.

F.08.3 Interface to Processing

These data will be used in developing the Polar Cloud Mask Product and the same interface issues listed in Section F.04.3., also apply to this ancillary data set.

F.08.4 Ingestion Route

These data currently reside at the EDC DAAC where ASTER is being processed (these data sets are already part of the Version 0 Pathfinder and IMS Efforts). No real ingestion is needed for EOS Time frame.

F.08.5 Verification

All global data sets appear to have varying quality at different areas of the globe. SEAWiFS Project is using the DMA WVS data set which was compiled from 1:250,000 scale map sheets for the world. It is unknown if any effort will be made to produce the most accurate product available from all known source data by the EOS-AM Time frame. It also must be ascertained whether any of these data sets take into account the tidal effect for coast lines which will occur for select overpasses during the EOS-AM1 mission.

F.08.6 Group Responsible for Development

Similar development as is listed in Section F.07.6 of this Appendix.

F.08.7 Temporal Availability and Source Security

The DCW product of NGDC CD-ROM is being used by PGS Toolkit Development Group already and will be included as part of October, 1994 Toolkit Delivery. The CIA WDB II is freely available.

F.08.8 Backup source

The CIA WDB II data base is freely available. Efforts to get the WVS product from the SEAWiFS Project should be made.

F.08.9 Schedule for Source, Ingestion Route and Associated Developments

Distributing the DCW Data with the October, 1994 PGS Toolkit delivery may be advantageous to help SPS developers understand how to interface and interpolate with this data set.

F.08.10 Testing

Data sets are available for testing.

F.09 Conclusions

F.09.1 Critical Dependencies and Sources

An obvious critical dependency is the GAP data which is needed for developing the surface radiance products which are the basis for most other ASTER Standard Products. NOAA NMC data are readily available and it seems obvious support for obtaining this data set will occur. The ASTER ST would like to use MODIS water vapor and temperature profile products in place of some NMC Analysis Products once they become available.

The MISR Aerosol Product is a new product and its availability after the launch of AM1 is uncertain. The ASTER ST will have backup data in place to balance this risk.

F.09.2 Implications for PGS Toolkit Ancillary Data Handling Tools

The ASTER ST and PGS Team will use the ADH Tools if they find the tools provided meet their processing requirements. Certain members of ASTER ST have the necessary ADH Tools in place and their acceptance of the PGS Toolkit is uncertain. The scope of the ADH Tools, is currently being defined during the summer of 1994. The initial scope of the ADH tools will be included in the Fall, 1994 PGS Toolkit Delivery.

F.09.3 Implications for PGS Pre-Processing and ECS Interfaces

The Q/A of ancillary data sets used in standard processing needs to be defined. Even before, understanding the Q/A done by the producing entity may help reduce concern of data quality that has been voiced by various AM-1 Teams. If Q/A issue is resolved this may reduce operation efforts in the PGS and the amount of preprocessing required for the various ancillary data sets.

The requirement by ASTER ST for the use of the MISR Aerosol Product could create a substantial preprocessing of MISR Level 2 data as input into ASTER SPS. Uncertainty exists because the processing scenario for ASTER is still being defined as far as the timing of processing of ASTER data initially in Japan and then shipping Level 1B data back to the U.S. It may be the case that the MISR data will have been processed into a Level 3 Gridded Product and some of the preprocessing of MISR Level 2 data will no longer be relevant, (Level 3 MISR Products are slated for production one year after the launch of EOS-AM1).

F.09.4 Outstanding Issues

For the ASTER ST and PGS Team the outstanding issues are:

1. The interfaces between the ASTER SPS and other AM-1 Instrument data products

2. The amount of Q/A that will be done on ancillary data used in standard product generation.

Appendix G AIRS

G.01 Introduction

AIRS standard processing is dependent on a number of ancillary data inputs, particularly in the use of various parameters as First Guess fields to the AIRS Level 2 retrieval algorithm. Figure G-1 displays the external data inputs which will be required for AIRS Level 2 processing. This high level diagram of AIRS processing was constructed on the basis of the SPSO tables, the AIRS Data Product Development Plan document and conversations with AIRS team members.

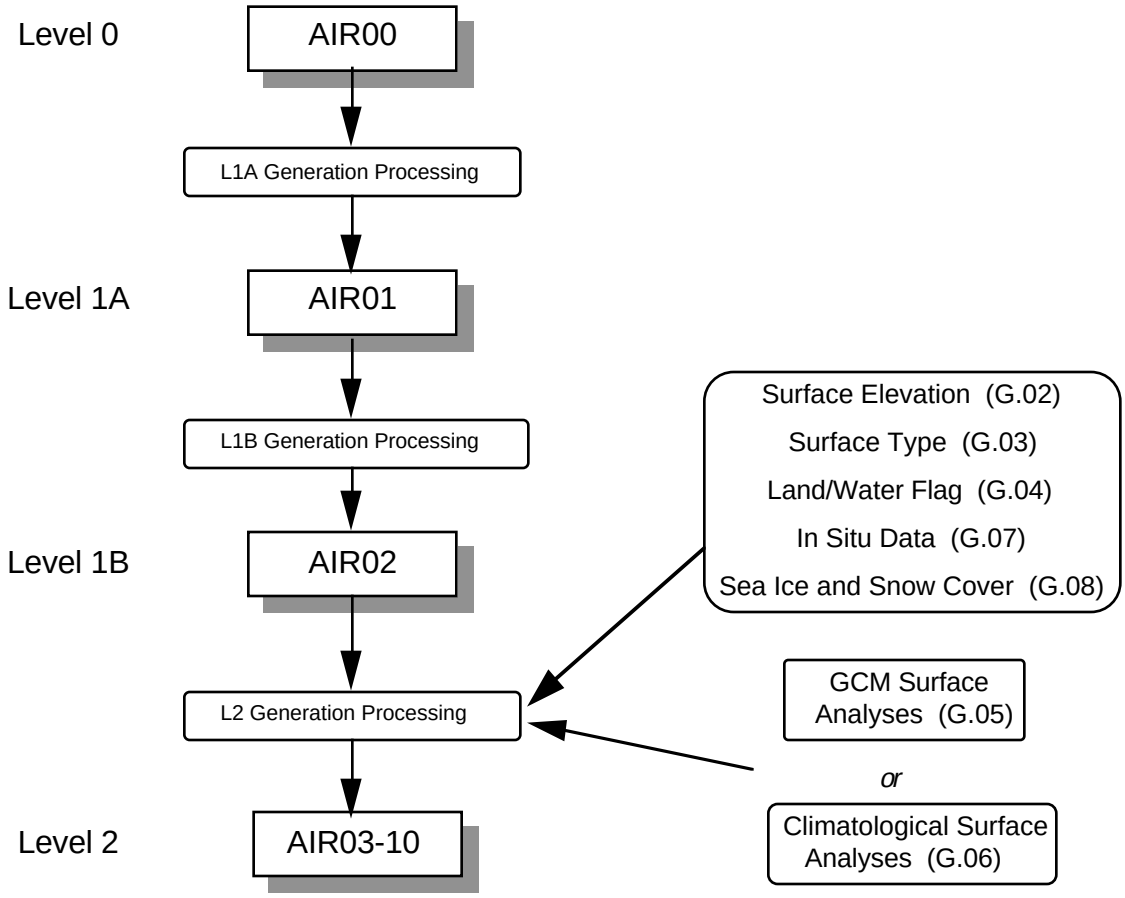


FIGURE G-1 External Inputs to AIRS Processing

G.02 Surface Elevation

G.02.1 Introduction

Information on surface elevation will be required as Ancillary data in the AIRS processing which generates the AIRS Level 2 products. Surface elevation values will be used to estimate surface pressure as an First Guess input to the AIRS Level 2 retrieval algorithm. This parameter is SPSO external option N065.

G.02.2 Source and Source Data set Attributes

Input	**DCW_Global_DEM**
Parm #	340
Parm/ Product Name	Surface Elevation from DEM
Instrument	N/A
Platform	N/A
DAAC/ADC	ECS
from	Jan-1995 (est.)
to	N/A
GB/day	N/A
Units	1 km (horizontal); meters (vertical)
Accuracy (Abs:Rel)	Rel. Accur: Horizontal - 600 C.E. Vertical - (+/-) 144 m
Temporal Res.	based on Oper. Nav. Charts
Horizontal Res:Cover	1 km
Vertical Res:Cover	100 m

The AIRS team has indicated that their DEM requirements are for a minimum of a 1~2 km resolution surface elevation field. Currently, the only DEM identified by ECS at that resolution is elevation data taken from the Digital Chart of the World data set. The source for this data is expected to be an ECS maintained data set derived from the DCW.

G.02.3 Interface to Processing

As an input to AIRS Level 2 product generation, the preparation required for the DEM data set is expected to be a one time effort before launch. It is anticipated that the PGS Toolkit routine PGS_AA_DEM will meet AIRS' access needs for this data.

G.02.4 Ingestion Route

DCW surface elevation products are expected to be provided by ECS.

G.02.5. Group Responsible for Development

TBD

G.02.6 Testing

ECS development of the DCW, as well as the tools to access it, will take place during the summer of 1994. The static surface elevation data set derived from the DCW database and the tool(s) to access it should be available by Fall 1994.

G.03 Surface Type

G.03.1 Introduction

Information on surface type, namely the vegetation index and/or soil type, will be required as Ancillary data as a First Guess input to the AIRS Level 2 retrieval algorithm. This parameter is SPSO external option N066.

G.03.2 Source and Source Data set Attributes

Input	TJTG01	EcoSystems CD-ROM
Parm #	331	331
Parm/ Product Name	Vegetation Index	Vegetation
Instrument	AVHRR	N/A
Platform	POES	N/A
DAAC/ADC	NESDIS	ECS
from	Jan-1990	?
to	Jan-2010	?
GB/day	?	N/A
Units	NDVI	?
Accuracy (Abs:Rel)	?	?
Temporal Res.	weekly	N/A
Horizontal Res:Cover	24 km :: global	?
Vertical Res:Cover	N/A	?

Although AIRS has not identified a particular source, the two data sets listed above seem to be possible sources. It is not clear whether the static Ecosystems data developed by NGDC or the weekly AVHRR NDVI data best suit the Ancillary data requirements for AIRS.

G.03.3 Interface to Processing

As an input to AIRS Level 2 product generation, the preparation required for the Ecosystems vegetation data is expected to be a one time effort before launch.

G.03.4 Ingestion Route

Data sets containing surface type will be available electronically from NESDIS (AVHRR) or will be made available by ECS (Ecosystems data).

G.03.5 Verification

TBD

G.03.6. Group Responsible for Development

ECS will develop tools to access the data in the Ecosystems CD-ROM. If there are any AIRS-specific preprocessor requirements, they should developed by the AIRS data processing team.

G.03.7 Temporal Availability and Source Security

Operational AVHRR vegetation products are assumed to be available operationally from NESDIS. NGDC-developed Ecosystems vegetation data will be static and maintained by ECS.

G.03.8 Backup source

No backup source has been identified.

G.03.9. Schedule for Source, Ingestion Route and Associated Developments

The tools for basic non-HDF read/write should be available by Spring '94.

G.03.10 Testing

The static Ecosystems data and the tool(s) to access it should be available for testing purposes by Fall 1994.

G.04 Land/Water Flag

G.04.1 Introduction

Land/water classification information will be required as Ancillary data in the generation of AIRS Level 2 products. The Land/Water flag will particularly be used in the creation of the Level 2 AIRS Surface Analysis product AIR06, which contains Sea Ice, Snow Cover and Sea Surface Wind Speed products. This parameter is SPSO external option N063.

G.04.2 Source and Source Data set Attributes

Input	**DCW_LND_SEA**
Parm #	233
Parm/ Product Name	Land/Water Flag from Digital Chart of the World
Instrument	N/A
Platform	N/A
DAAC/ADC	ECS
from	?
to	?
GB/day	N/A
Units	?
Accuracy (Abs:Rel)	1 - 3 km
Temporal Res.	N/A
Horizontal Res:Cover	1 : 1,000,000
Vertical Res:Cover	N/A

The source for this data is expected to be a ECS maintained data set derived from the Digital Chart of the World data set.

G.04.3 Interface to Processing

As an input to the AIRS Level 2 generation process, the preparation required for this Land/Water data set is expected to be a one time effort before launch. It is anticipated that the PGS Toolkit routine PGS_AA_DCW will meet AIRS' access needs for this data.

G.04.4 Ingestion Route

DCW surface classification products are expected to be provided by ECS.

G.04.5. Group Responsible for Development

If there are AIRS-specific preprocessor requirements, they should developed by the AIRS data processing team.

G.04.6 Testing

The development of the DCW, as well as the tools to access it, will take place during the summer of 1994. The static land classification data set and the tool(s) to access it should be available for testing purposes by Fall 1994.

G.05 General Circulation Model Surface Analyses

G.05.1 Introduction

General Circulation Model (GCM) surface analysis products will be required as Ancillary data for the generation of Level 2 AIRS products. Temperature, humidity and surface pressure parameters from GCMs will be used as a first guess input to the Level 2 retrieval algorithm. These analyses are SPSO external option N059.

G.05.2 Source and Source Data set Attributes

Input	GCM/NMC	GCM/NMC	GCM/NMC
Parm #	227	228	229
Parm/ Product Name	GCM, Surface Air Pressure	GCM, Surface Air Temperature	GCM, Surface Humidity
Instrument	N/A	N/A	N/A
Platform	N/A	N/A	N/A
DAAC/ADC	NWS	NWS	NWS
from	?	?	?
to	?	?	?
GB/day	?	?	?
Units	?	?	?
Accuracy (Abs:Rel)	?	?	?
Temporal Res.	?	?	?
Horizontal Res:Cover	?	?	?
Vertical Res:Cover	?	?	?

AIRS has indicated that NMC and DAO are the potential sources for this GCM information, and that their requirements are for 1x1 degree resolution.

G.05.3 Interface to Processing

Horizontal interpolation may be required in order to meet AIRS' resolution requirement. This reformatting may be performed by a TBD ECS tool which will be designed to reformat and prepare data to a common access format.

G.05.4 Ingestion Route

The ingestion route for NMC data may be arranged by ECS such that all DAAC access to the data would be centralized at one location.

G.05.5 Verification

TBD

G.05.6. Group Responsible for Development

If the ECS supplied internal access format tools do not meet AIRS' requirements, it remains to be seen other instruments have similar GCM data requirements. If such a case, the function of common preparation of the data should be assumed by ECS.

G.05.7 Temporal Availability and Source Security

TBD

G.05.8 Backup source

The Climatological analyses described in section G.06 are the backup to GCM analysis data.

G.05.9. Schedule for Source, Ingestion Route and Associated Developments

The tools for basic non-HDF read/write should be available by Spring '94.

G.05.10 Testing

TBD

G.06 Climatological Surface Analyses

G.06.1 Introduction

Climatological surface analysis products will be required as Ancillary data in the generation of AIRS Level 2 products. This will include climatology on temperature, humidity, surface pressure and sea surface temperature values. While GCMs (G.05) will be the primary source of temperature, humidity and surface pressure data, climatological data provides a secondary source of a First Guess input to the AIRS Level 2 retrieval algorithm. These parameters are SPSO external option N067.

G.06.2 Source and Source Data set Attributes

Input	Temperature Profiles	Humidity Profiles	Ozone Profiles	Sea Surface Temperature Profiles	TDTG01
Parm #	261	262	263	264	264
Parm/ Product Name	Climatology Data; Temperature Profiles	Climatology Data; Humidity Profiles	Climatology Data; Ozone Profiles	Climatology Data; Sea Surface Temperature Profiles	Sea Surface Temperature climatology
Instrument	N/A	N/A	N/A	N/A	AVHRR
Platform	N/A	N/A	N/A	N/A	POES
DAAC/ADC	NWS	NWS	NWS	NWS	NESDIS
from	?	?	?	?	Jan-1990
to	?	?	?	?	Jan-2010
GB/day	?	?	?	?	0.001435
Units	?	?	?	?	C
Accuracy (Abs:Rel)	?	?	?	?	(+/-) 0.5C
Temporal Res.	?	?	?	?	24 hours & 7 days
Horizontal Res:Cover	?	?	?	?	N / A : : Global (70N - 70S)
Vertical Res:Cover	?	?	?	?	N/A

AIRS has indicated that NMC and DAO analyses are the potential sources for the various Climatology information. AIRS has also stated that their resolution requirements are 1x1 degree for monthly mean climatologies of temperature, humidity and sea surface temperature, and that their requirement for a monthly mean ozone climatology is 2x2.5 degree. Also, although it has not been identified by AIRS, a weekly AVHRR climatology product has been listed as an option for the required sea surface temperature parameter.

G.06.3 Interface to Processing

Horizontal interpolation may be required in order to meet AIRS' resolution requirement. This reformatting may be performed by a TBD ECS tool which will be designed to reformat and prepare data to a common access format.

G.06.4 Ingestion Route

The ingestion route for NMC data may be arranged by ECS such that all DAAC access to the data would be centralized at one location.

G.06.5 Verification

TBD

G.06.6. Group Responsible for Development

TBD.

G.06.7 Temporal Availability and Source Security

TBD

G.06.8 Backup source

No backup sources have been identified at this time. The climatological data described in this section are being used as a backup source to the GCM surface analyses described in G.05.

G.06.9. Schedule for Source, Ingestion Route and Associated Developments

The tools for basic non-HDF read/write should be available by Spring '94.

G.06.10 Testing

TBD

G.07 In Situ Data

G.07.1 Introduction

In situ data products, such as radiosonde, ship, buoy and aircraft observations will routinely be required as Correlative data to be used in the validation, algorithm development and reprocessing of AIRS Level 2 data. In situ data appear as SPSO external options N0060 and N0062.

G.07.2 Source and Source Data set Attributes

Input	NMC_BUFR	NMC_BUFR	NMC_BUFR	NMC_BUFR
Parm #	46	744	231	232
Parm/ Product Name	Radiosonde soundings, Temperature	Radiosonde soundings, Temperature	Radiosonde soundings, Humidity	Radiosonde soundings, Humidity
Instrument	N/A	N/A	N/A	N/A
Platform	N/A	N/A	N/A	N/A
DAAC/ADC	NWS	NWS	NWS	NWS
from	?	?	?	?
to	?	?	?	?
GB/day	?	?	?	?
Units	?	?	?	?
Accuracy (Abs:Rel)	?	?	?	?
Temporal Res.	?	?	?	?
Horizontal Res:Cover	?	?	?	?
Vertical Res:Cover	?	?	?	?

NMC is expected to be the source for the required in situ data. The product name NMC_BUFR refers to the BUFR format of many NMC analysis products

G.07.3 Interface to Processing

AIRS has stated that the in situ data will be processed weekly with AIRS temperature retrievals. This processing will generate tuning parameters for the improvement of subsequent temperature retrievals.

G.07.4 Ingestion Route

The ingestion route for NMC data may be arranged by ECS such that all DAAC access to the data would be centralized at one location.

G.07.5 Verification

TBD

G.07.6. Group Responsible for Development

TBD

G.07.7 Temporal Availability and Source Security

In situ data is assumed to be available routinely from NMC.

G.07.8 Backup source

No backup sources have been identified.

G.07.9. Schedule for Source, Ingestion Route and Associated Developments

The tools for basic non-HDF read/write should be available by Spring '94.

G.07.10 Testing

TBD

G.08 Sea Ice and Snow Cover

G.08.1 Introduction

Snow cover and sea ice data products will be required as Correlative data to be used in the validation, algorithm development and reprocessing of AIRS Level 2 processing. They will particularly be used in the generation of AIR06, the Level 2 AIRS surface analysis sea ice, snow cover and surface wind speed products. These parameters appear as SPSO external option N0068.

G.08.2 Source and Source Data set Attributes

Input	**TJZN01**	**AVHRR_ WEEKLY_ SNOW**	**SSMI_ SNOW**	**AVHRR_ ICE**
Parm #	337	337	337	337
Parm/ Product Name	Snow cover analysis (chart)	Digitized snow cover analysis	Snow cover/ sea ice concentration	Ice Edge; mapped AVHRR ice
Instrument	AVHRR	AVHRR, VISSR	SSM/I	AVHRR, etc.
Platform	POES	GOES/POES/ METEOSAT/ GMS	DMSP	various
DAAC/ADC	NESDIS	NESDIS	NESDIS	NESDIS
from	Jan-1990	Jan-1990	Mar-1991	?
to	Jan-2010	Jan-2010	?	?
GB/day	?	?	?	?
Units	N/A	?	Snow cover index :: sea ice concentration %	?
Accuracy (Abs:Rel)	N/A	?	?	?
Temporal Res.	weekly	weekly	6 hours	weekly
Horizontal Res:Cover	4 km :: global	?	25 km :: orbital swaths	?
Vertical Res:Cover	N/A	N/A	N/A	N/A

Input	MIM18	MIM22	MIM23
Parm #	3713A	3611A	3609A
Parm/ Product Name	Snow Depth	Sea Ice Concentration	Sea Ice Type
Instrument	MIMR	MIMR	MIMR
Platform	PM	PM	PM
DAAC/ADC	NSIDC	NSIDC	NSIDC
from	Dec-2000	Dec-2000	Dec-2000
to	Jun-2006	Jun-2006	Jun-2006
GB/day	0.005	0.009	0.009
Units	?	?	?
Accuracy (Abs:Rel)	?	2% :: ?	3% :: ?
Temporal Res.	1/day	1/day	1/day
Horizontal Res:Cover	25 km : Land	12 km :: Ocean	12 km :: Ocean
Vertical Res:Cover	N/A	N/A	N/A

AIRS has previously identified the weekly NOAA Snow and Ice charts (TJZN01) as possible source, but several alternatives are listed above which have a wide variety of temporal resolutions.

G.08.3 Interface to Processing

Use of the various snow cover and sea ice data in AIRS Level 2 generation processing as Ancillary data will require TBD preprocessing.

G.08.4 Ingestion Route

MIMR Level 2 snow cover and sea ice products will be transferred from the NSIDC DAAC in HDF format. AVHRR, SSM/I and AVHRR composite snow cover and sea ice products are assumed to be available in near real time electronically from NESDIS via the SAA.

G.08.5 Verification

TBD

G.08.6. Group Responsible for Development

If there are any AIRS-specific preprocessor requirements, they should developed by the AIRS data processing team.

G.08.7 Temporal Availability and Source Security

MIMR products should be available for AIRS processing. Snow cover and sea ice data from NESDIS is assumed to be available operationally.

G.08.8 Backup source

Although not identified by AIRS, MIMR and SSM/I snow cover and sea ice products might serve as adequate backup sources.

G.08.9. Schedule for Source, Ingestion Route and Associated Developments

The tools for basic non-HDF read/write should be available by Spring '94. The tools for basic HDF read/write should be available by Fall '94.

G.08.10 Testing

TBD

G.09 Conclusions

The major external inputs to AIRS standard processing are several GCM and climatological surface analyses which will be required as First Guess fields in the Level 2 retrieval algorithm and which should all be available from NMC and/or DAO.

AIRS processing does not have any primary data source requirements for any EOS instrument data other than EOS-PM AMSU and MHS instrument data; Level 0 AIRS, AMSU and MHS data will be processed in the same processing string at the GSFC DAAC.

Further discussion with the AIRS team is needed regarding their format requirements for input data to their Level 2 processing algorithms, as well as what PGS tool interfaces are foreseen.

Appendix H Data Assimilation Office

H.01 Introduction

The DAO is both a major user of EOS and non-EOS products as ancillary inputs and a producer of products potentially usable as ancillary inputs to instrument products.

Requirements have been gathered by SPSO for DAO as an IDS investigator. In this sense DAO is an EOSDIS user. However, the routine nature of DAOs requirements mean that it should be considered a 'sink' for ancillary inputs much like other instruments. It is currently understood that DAO's requirements for non-EOS data will be met by their own efforts. Their requirements for EOS products have not been updated since the IDS exercise several years ago.

Consequently it is not yet clear whether it is necessary for ECS to address the issue of ancillary data for DAO in terms of toolkit or pre-processing. Further requirements gathering and policy clarification is therefore required.

This chapter is left blank until these new inputs are received.

Appendix I

Tables A,B,C

Key to tables

instrument	Instrument analyzed
general requirement	Derived from SPSO table T-5 (fixed means input indicated in coded dependency column)
detailed requirement	 itto
input	the ancillary or dependent data set identified to meet the general and detailed requirement
parm #	parameter no.. For EOS products this is the SPSO product parameter no. while for non-EOS inputs its the SPSO label.
parm/product Name	the name of the input
other name	additional names for input
instrument	the instrument providing the input
platform	the platform carrying the instrument
DAAC/ADC	the source of the input
from/to	input availability start/stop time
granule	size of input granule
format	input format
structure	internal structure of input data set
GB/day	volume of input per day
units	of input
accuracy	of input
temporal resolution	of input
horizontal resolution	of input
vertical resolution	of input

parent	requirement label (N0) or product requesting input
PGS Tool	the name of the PGS toolkit tool likely to be used (assumes root PGS_AA_)
pre-processing	type of pre-processing required FM reformatting from external formt ST subsetting SP sub-sampling AG aggregation of inputs
priority	H(igh), M(edium) or L(ow); suggested for pre-processing development
section	Section in report refering to the input